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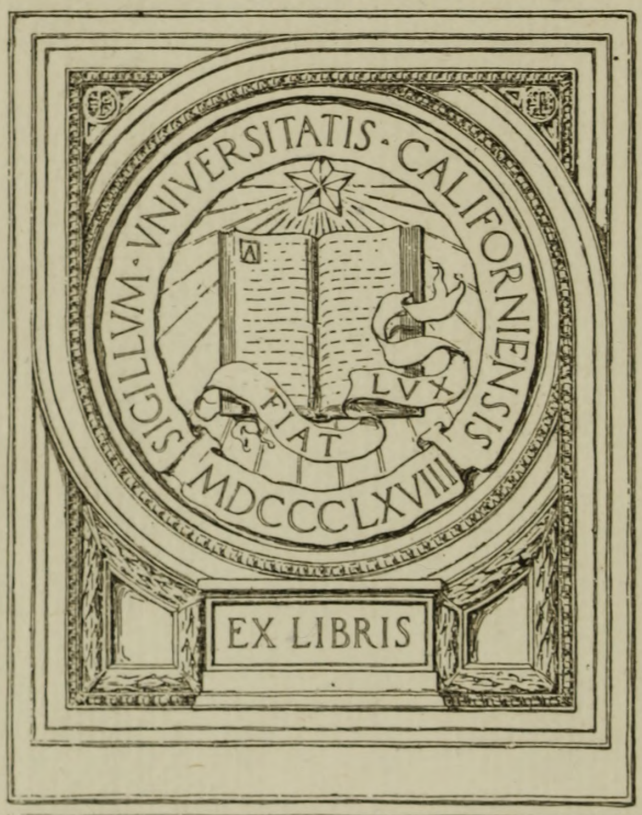

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A TREATISE

ON

DISEASES OF THE JOINTS.

A TREATISE

ON

DISEASES OF THE JOINTS

BY

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PREFACE TO SECOND EDITION.

For some considerable time a Second Edition of my Treatise on Diseases of the Joints has been called for, and indeed, though never ceasing to study clinically and anatomically these affections, I began twelve years ago more especially to prepare my materials and myself for its production. Soon after 1861, whether the appearance of my First Edition was the stimulus, or merely fortuitously I know not, many excellent essays were published, and much careful investigation was undertaken here, in America, in Germany, and in France; moreover, personal experience and research had provided me with a quantity of material. Hence, it became more and more evident as time went on that the Second Edition must undergo such enlargement and revision, that it appeared to me better to re-write the whole book. In its present form, therefore, the Treatise contains but a few words here and there of the First Edition.

Nevertheless, the lines of construction are, to a considerable extent, the same; especially does experience show me, that the distinction which I at first drew, but which has been much criticised, between such maladies as commence in the synovial membrane and such as begin in the bones, must be maintained by him who would afford to his patients the full

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benefit of a treatment founded on accurate and scientific diagnosis.

Plainly may it be foreseen, that the doctrine of certain absorptive diseases discussed in Chapter IV. will meet with criticism, even with scepticism. I, myself, long doubted if such pathological sequence stood in the true relationship of cause and effect; but, even while thus hesitating, several perfectly characteristic cases, following each other in rapid succession, left no room for ambiguity.

The volume should, if possible, have been smaller in bulk; but even as it is, much that might have been said has been omitted. I hope, however, that the book may not be found either tedious or wearisome; if only it meet with a reception as favorable as that of the earlier edition, my aspirations as to its fate will be amply fulfilled.

RICHARD BAEWELL.

32 GEORGE STREET, HANOVER SQUARE,
LONDON, W.
February, 1881.

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A TREATISE

ON

DISEASES OF THE JOINTS.

CHAPTER I.

PATHOLOGICAL ANATOMY.

It is more than probable that my readers are well acquainted with the anatomy of joints ; yet I offer no apology for beginning this treatise with an account of the form and minute structure of articulations, and for these reasons : if he who takes up this volume have not followed pretty closely the most recent microscopical studies, he will not know what in this chapter I shall hope to explain ; while if he have pursued those inquiries, he must be aware that certain considerable differences of view exist. Unless my anatomical opinions are postulated and defined, the pathological considerations to be encountered hereafter must, without some foundation, be mere castles in the air.

The diarthrodial or movable joint will almost exclusively occupy our attention, but one form of the synarthrodial, viz., amphiarthrosis, is not strictly immovable, and one such articulation must for a little space claim our notice. Yet, although the amphiarthrosis is not in our sense a joint, the fibres and fibro-cartilages which separate, and at the same time unite the bones, permit, by their flexibility, a certain mobility, facilitated in another part by the interposition of a synovial bursa, not, be it distinguished, a synovial membrane.

To our idea of a diarthrodial joint are necessary a distinct cavity lying between and separating the bones of the articulation, also at least two pieces of cartilage interposed between those bones ; each piece of cartilage lining the end of each bone is not continuous, but in contact, with the other. The gliding, rolling, or twisting movement must take place between these cartilaginous surfaces, kept moist by a secreting membrane, which closes in the cavity of the joint. The essential constituents then of a diarthrodial joint are :

1st.—The bones, which are in apposition, but separated from each other by a cavity.

2d.—The cartilages of incrustation.

3d.—The synovial membrane.

But besides these are :

4th.—Ligaments binding the bones together.

5th.—Frequently an interarticular fibro-cartilage.

The bones which enter into the formation of a joint may be two or more. In the scapulo-humeral articulation is an instance of two bones jointed together ; in the elbow of three, but two of these only are essential to the joint as a hinge, the other being added for purposes of its own (if it may be so expressed). In the ankle are three bones essential to the joint, two forming a socket, into which the head of the third is received. The hip-joint is composed in early life of four bones, but later it abrogates this peculiarity, the three which formed the socket becoming united into one. The shape of the articulating surfaces of the bones determines the species and form of the joint. Descriptive anatomy divides them into four classes :

1st.—Arthrodia, or flat-joint.

2d.—Enarthrosis, or ball-and-socket-joint.

3d.—Ginglymus, or hinge-joint.

4th.—Diarthrosis, or pivot-joint.

The different species of movement which these forms of articulation permit have been the subject of more or less elaborate treatises ; but the shape of the joint surface has no influence on the action of its diseases. Although, then, for purposes of diagnosis and of treatment, every surgeon must be well acquainted with the form of the surfaces, as with the sort and extent of motion normally permitted by each articulation, yet it does not appear desirable to describe here what may be found in every adequate anatomical work.[1]

It is not necessary to give here an account of the ossifying process in cartilage, nor is it my desire to append an unnecessary and therefore pedantic description of bone-tissue ; but, in order that the pathology of certain joint diseases may be regarded from the same point of sight as is taken in this work, it is desirable that the author's views of osseous structure should be clearly expounded. Bone is generally described as a compound of cartilage and phosphate of lime, plentifully supplied with vessels, among which a large number of branched cells are arranged in a more or less definite order. Let us describe the structure in the same language differently placed, and say : Bone consists of a number of cells (connective-tissue corpuscles) whose interstices (intercellular spaces) are occupied by a compound of cartilage and phosphate of lime, and among which vessels pass in a certain definite relation. By adopting this method of description the

[1] Some controversy has taken place concerning the forces which during development determine the shape of articular surfaces ; some writers hold that these are primarily fixed, and that the muscles are afterward so attached as to impress on the bones such movements as are consonant with the form of the joint. Others believe that the mode of muscular attachment, and the motions so inaugurated, mould the bone extremities into the shapes we know them by. To me this appears something like the verbal puzzle as to which had the priority in creation, the egg or the hen. The process of fissuration in the limb cartilages, and the formation of muscle, take place in the fœtus at the same time, from the sixth to the eighth week ; but it is hardly possible to conceive that at that date a limb, as the thigh or arm, could enjoy such extended movement as to mould, press, or grind into form, a globular head and a round cavity ; or that the hand would be so dexterously and busily employed as to polish out of a formless matrix so perfect a circle and pivot as the head of the radius.

different elements of which bone is composed are reduced to their proper relation—first the cells, lying in cavities (cell-spaces), with many branches or canaliculi, then the intercellular substance, and then the vascular supply. The cells of the bone are contained in the lacunæ, the cell-walls line the spaces, and the nuclei may be seen within them. Messrs. Tomes and Campbell de Morgan state that they "have had no difficulty in finding the nuclei in recent bone without the aid of chemical treatment. If a small fragment be taken from the spongy portion of a fresh bone, and freed from adherent fat, the nuclei may be seen as small rounded bodies attached to the walls of the lacunæ."[1] Other observers, quoted by the above-named authorities, also believe in the persistence of the nuclei; viz., Goodsir, Schwann, Krause, Kohlrausch, Heischmann, Günther, Donders, and more recently a host of others, among whom Virchow and Neumann may be named. I possess many specimens, in which the nuclei are very evident. The lacunæ, and the cells contained in them, have not mere even, round, or oval walls, but branch out into a great number of fine processes, called by Todd and Bowman canaliculi; they are actual spaces in the hard tissue, containing a membranous matter, but whether the membrane itself be really tubular is doubtful. A section through the dense structure of a long bone, the humerus for instance, shows the following arrangement of parts. The whole mass of the bone is disposed round an axis, so that the section is ring-shaped; in the outer and inner edge of the section the disposition will be shortly described. Between these two parts the cells are seen usually to surround certain vessels in canals called Haversian, that run for the most part in the direction of the axis of the bone—the whole arrangement, canal and surrounding cells, is called an Haversian system—certain parts which fill up the interstices between these circles are named by Kölliker ("Mikroskopische Anatomie," p. 292) Interstitial Laminæ; by Quekett they are more happily termed "Haversian Interspaces" ("Histological Catalogue of the Museum of the College of Surgeons"). In the inner and outer layers of bone, or Circumferential Laminæ, the cells are arranged round the axis of the bone; most of them are of the ordinary size and shape of the lacunæ in the Haversian systems; but there are among them certain longer cells, some of which run at right angles,[2] others, seen on longitudinal section, parallel to the axis; thus there are in the layer next the medullary cavity, and next the periosteum, two sets of long cells, which run at right angles to each other. I believe these are intended for the rapid absorption and disintegration of both these strata.

Thus it will be understood that bone is to be considered simply as a connective, an areolar tissue, the ground substance of which has been saturated with lime-salts. In it are all the elements of that tissue as they may be found surrounding a vessel. There is the space in which the little vascular branch lies (Haversian canal); around it are arranged connective-tissue corpuscles (bone-cells) lying in cell-spaces (lacunæ) and provided with branches (canaliculi). But these parts, which represent the yellow element of areolar tissue, do not stand alone. In the lamellæ a little care and skill will bring into view the fibrous and often wavy form of the intimate bone-tissue itself, which is evidently calcified white areolar structure; for many occurrences in the process of ossification show that the

[1] Observations on the Structure and Development of Bone: Philosophical Transactions, 1853, p. 117.

[2] Messrs. Tomes and De Morgan On the Development and Structure of Bone: Philosophical Transactions, 1853.

primordial cartilage becomes quite changed by peculiar cell arrangement and proliferation previous to the deposit of lime. I hold that it is of great importance to the full comprehension of all bone disease, that its physiological anatomy and constitution should be thus considered.[1]

But it is of course to be noticed that no joint surface lies immediately upon hard solid bone, such as composes a shaft, but upon a reticulated or cancellated structure, *i.e.*, upon the epiphysal ends of long, or as at the carpus and tarsus upon short bones.

As the shaft of a newly ossified bone is solid, *i.e.*, has no central medullary cavity, so the epiphyses of long bones and the mass of short bones are at first without that subdivided cavernous hollow, which we know as the cancellous structure. The formation of these little inter-communicating cavities is due to a process of absorption, which commences in the middle of the nucleus as a secondary process, and while yet it is increasing centrifugally. Thus, however hard and solid the texture of a bone may be, the joint ends are always spongy (short bones are entirely so), that is, they consist of an outer cortex, enclosing a number of cancelli, which contain medulla, divided from each other by thin osseous plates, lamellæ. The lateral cortex, *i.e.*, those walls of the structure which do not look toward

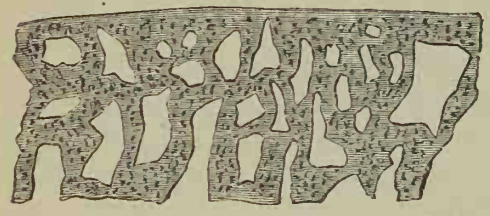

FIG. 1.—Cancelli and articular lamella from lower end of human tibia, magnified about 10 diameters.

FIG. 2.—Cancelli and articular lamella from lower end of human tibia, magnified 100 diameters.

the joint cavity, are very thin, and the lacunal arrangement is in general irregular, except where a vessel passing to the interior forms an Haversian canal and concentric laminæ. The lamellæ which branch from its internal surface, enclose the cancelli, and permeate the whole area of the short bone or epiphysis, are very variable in size and strength in different parts, in different persons, and at different ages; from .03 to .06 of an inch may be taken as a fair average of their thickness, the cavities about .6 to .3 in length and breadth. Each cavity is incompletely surrounded by lamellæ, there being open communications throughout from one to another, whereby blood-vessels freely pass and anastomose; these cancelli, which are lined by a fine membrane and contain medulla, are in mature long bones but a prolongation with infinite subdivisions of the central medullary cavity. The lamellæ appear at first sight to be arranged in an arbitrary, fortuitous manner; but examination of sections from dry specimens shows that they are so built up as to afford the greatest mechanical support to that part of the outer crust where most pressure will be exerted, especially therefore to that surface forming the joint; under that surface the cancelli are as a rule smaller and the lamellæ thicker.

[1] Many phenomena, some of which will shortly be noticed, show how often and how easily cartilage becomes thus metamorphosed into a more or less perfect areolar tissue. Indeed, although the primordial cartilaginous skeleton is in subsequent development changed into bone, yet it undergoes a previous modification in o a fibrous structure. This is described in all adequate works on histology, and we shall shortly meet with a brilliant example of such metamorphosis.

The plate of bone which lies next to the articular cartilage is very peculiar ; it is applied to the cancellous structure, but never roofs in a cavity. However nearly such cavity may approach the articular lamella, a plate of true bone always separates the one from the other. On section it is seen to consist of a very hard layer of irregular or serrated edge (in section), and also irregular at the part next the cancelli. It possesses no true bone lacunæ with canaliculi, but simply blots (in this view black and opaque), oval in form, whose long axes are perpendicular to the surface ; they are arranged linearly in the same sense, or rather the general trend of their arrangement is at right angles to the surfaces ; they are of the same size and outline as cartilage corpuscles. Except indeed for some difference in refraction and for its hardness, this lamella is, like the deeper layer of cartilage, altered by the deposition of lime-salts. Yet changed not only thus, for it is on examination with a high power (Hartnack 6) evident that fibrillation has preceded calcification, evidenced by very fine wavy striation in a direction perpendicular to the surface.[1]

The appearance of these lines is the more noteworthy since the laminar strata in the bone immediately underlying this layer is in a contrary direction, viz., parallel to the surface. The lines are not evenly distributed throughout, but are, as it were, gathered into bundles, which appear to correspond to the position of a black corpuscle. They are most readily perceptible in specimens that have been ground thin, yet are also quite distinct in those that have been decalcified. If the specimen be very much soaked in absolute alcohol and mounted in dammar, the varnish runs into the wavy lines, and is apt to obscure them. The lamella is cartilage which has become fibrillated and received a deposit of lime, but has not become true bone because it lies beyond the limit of the ossifying force ; hence decalcification causes the spots, which in sections ground thin appear as black spots, to regain all the characters of normal cartilage-corpuscles. This layer is rather a part of the encrusting cartilage than of the bone, and pathological conditions will hereafter show that in all changes it sides with, and shares the fate of, the former structure.

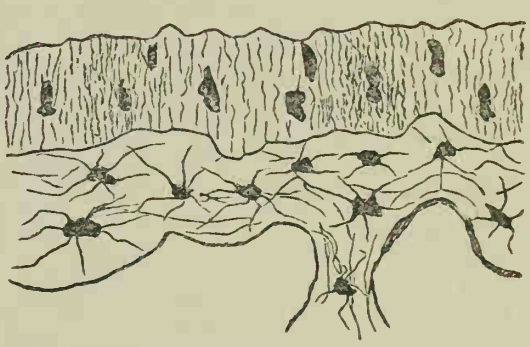

FIG. 3.—The articular lamella, highly magnified.

The articulations, lying at an adult age on the ends of long bones, are in early life not quite thus placed, since at that period the joint ends are separated from the shafts. At a very early age, therefore, the articulation is not formed by bone at all, but by two pieces of cartilage, and it is not until babyhood has been left behind that there is any true articular cartilage, or any such structures as have just been described. An articular cartilage can only be said to exist when ossification of the epiphysis is complete. Yet long after this period, which varies in different localities, the epiphysal end of the bone remains separated from the diaphysis by a disk (in section a line) of cartilage. At the junction of the shaft with the epiphysal line that addition to the length of the bones, on which increase of

[1] In my former edition I described these as very fine tubules ; therein was the error. The markings are not tubes in the sense of continuous elongated hollows; nevertheless they are, I believe, pores permitting the transmission of fluid.

stature depends, chiefly takes place, although on the other, the epiphysal side of this line, a certain amount of growth is going on. This plastic activity necessitates, and is accompanied by, considerable blood-supply, and vascular excitement, which under certain circumstances may overstep the limits of physiological and pass into pathological conditions. While their growth is going on, the epiphysal end divided from the shaft is quite independent in its vascular and nutrient supply—as independent of the diaphysis as one short bone of the carpus, for instance, is independent of the others; no vessel penetrates the epiphysal disk from the one portion to the other. These two latter circumstances, the plastic activity and the epiphysal isolation, produce certain differences in the physiological and pathological status of these joints, before and after the period of union to the shaft. It is, therefore, important to know when that union takes place.

The annexed table gives the ages at which in different bones the epiphysal nucleus appears, as also the period of union to the shaft.

		Nucleus appears.	*Epiphysis unites.*
Humerus	Upper	2d year	20th year.
	Lower	Capitell., 3d year; Trochlea, 11th year	16th or 17th year.
Radius	Upper	6th year	17th year.
	Lower	2d year	20th year.
Ulna	Upper	10th year	17th year.
	Lower	4th year	20th year.
Metacarpus and Phalanges		3d to 5th year	20th year.
Pelvis	Y Cartilage	about 14th year	17th or 18th year.
Femur	Upper	1st year	18th year.
	Lower	8 months (fetal)	21st to 24th year.
Tibia	Upper	before birth	21st to 22d year.
	Lower	2d year	18th year.
Fibula	Upper	3d or 4th year	24th year.
	Lower	2d year	21st year.
Metatarsus Phalanges		3d to 8th year	19th to 21st year.

The four inner metacarpal and metatarsal bones have distal, the outer, proximal epiphyses. All the phalanges have the epiphyses proximal—thus all the metacarpo-phalangeal joints, save that of the thumb, are on two epiphyses; so at the foot all metatarso-phalangeal joints are doubly epiphysal except the hallux.

Moreover, the relationship between the epiphysal disk and the capsule of the joint is a matter of great import in the interpretation and prognosis of certain diseases. At some articulations these two parts hardly come into relationship, at others a part, in some the whole, of the epiphysal line is included in the synovial membrane. The following list gives the interrelation of these parts for different joints.

The Shoulder.—The capsule with its synovial lining is attached above to the margin of the glenoid cavity, which is not an epiphysal bone, below to the anatomical neck of the humerus. The two, sometimes three, ossific nuclei which form the upper part of the humerus-head and tuberosities, unite at the age of five or six years, and thus form a simple epiphysal end. The line of junction between this and the shaft runs from the inner incur-

vation of the groove called anatomical neck outward and generally a little downward to a point a little below the lowest projection of the tuberosities. There is then but a little piece of the epiphysal junction on the internal aspect of the bone which lies within the synovial membrane or close to its attachment.

The Elbow.—All three bones which form this joint have a very narrow epiphysal end (from above downward) ; hence it happens that all three lines of junction are within the synovial membrane. The activity of growth is not here so great as at some other joints. The epiphysal line of the olecranon is so placed that only its anterior edge interests the joint cavity.

The Wrist-Joint is somewhat complicated. A single synovial sac lines the surface of the radius and the distal surface of the ulnar interarticular cartilage; the upper bones of the joint and also the scaphoid, semilunar and cuneiform, the lower constituents. This is the wrist-joint proper, but the adjacent synovial membranes must be remembered. One of these lines the radio-ulnar articulation, and the junction between the ulnar and its fibro-cartilage. Another lubricates the joint between the first and second row of tarsal bones and also the carpo-metacarpal joints. The radial and ulnar epiphysal junction are not included in the first-named synovial membrane. As an epiphysal has already been described as analogous in its isolated mode of nutrition to a short bone, we must remember that the similitude holds good on that point in regard to the carpal bones. Yet we must also remember that the growth of a long bone from its epiphysal end is very considerable, the plastic and vascular excitement very marked. The increase on the small carpal bones is much less, and the formative activity can hardly be compared to that which occurs at the ends of a growing long bone.

The Hip-Joint.—At the time of birth the femur has no real neck, a mere constriction separates the head (large in proportion) from the trochanters. Along this groove the capsule and synovial membrane are attached. After the child has passed the first two or three weeks of life, this part of the skeleton begins to grow, a neck is formed from the *shaft* of the bone, to which also a considerable part of the head belongs. The ossification at this upper end runs in the form of a wedge upward, so that all the upper extremity of the diaphysis lies between the epiphysal part of the head and the apophysal centre for the great trochanter. All this part (including of course the head) is enclosed in the synovial membrane, and the necessary great hyperplasia and hyperæmia is within the cavity of the hip-joint. Also one aspect of the Y-shaped cartilage of the immature acetabulum lies inside the synovial membrane.[1]

At the Knee.—The anterior edge of the femoral epiphysis at the knee is the only junction within the joint-cavity.

Ankle.—The synovial membrane of the ankle-joint does not come into relation with the epiphysal junction.

That part of the epiphysis or of a short bone which remains unossified toward the joint-cavity is (p. 4) separated by a peculiar structure from the ordinary bone-tissue, and now becomes articular cartilage. It is not, as it has often been said to be, attached to the bone, but it is continuous with it: it is part of the same thing, one portion having received a deposit of lime, the other not having done so. It varies in thickness according to the shape of the surface, and always so that its form is an exaggeration of that of the bone: thus, if the osseous surface be concave, the cartilage is thickest at its edges, so that it is more concave than the bone itself. If, on the

[1] For further remarks on this subject, see Chapter XIV.

contrary, we take a convex example, the cartilage will be found thinnest at the edges, so that the whole shape is more convex than the osseous surface.

Cartilage is a tough elastic material, of a semitransparent bluish appearance, and easily cut with a knife. If boiled for several hours in water, more rapidly if in diluted acetic acid, or if treated cold in almost any strong acid, it is dissolved into a jelly, which Müller called *chondrin*, and which differs very little from gelatine. If thin sections be made through the substance of the cartilage and examined by a quarter-inch power, the whole substance will be found to be very translucent, and to have a finely mottled or granular aspect; and there will be seen in it a great many bodies of an oval form. Some confusion has arisen from these having been named cartilage-cells. The truth is, that they are cavities in the hyaline substance, having no lining membrane, which contain from two to six nucleated cells. I propose to call throughout this treatise each body, *i.e.*, cells and hollow, the cartilage-corpuscle, reserving the word cartilage-cell for each one of the bodies contained in the cavity. These cells may, under various forms of treatment, be made to shrivel; when their enveloping membrane is detached from the walls of the cavity, is thrown into folds, the shrunken cells may be seen loose within the hollow. Luschka found this to follow the addition of water; Albert, continuous electric shocks. The cells in the corpuscle not unfrequently, while near the attached surface, separate and cause a division by fissure of the hollow into new corpuscles, and the observer will find the arrangement of these bodies somewhat peculiar, for if he examine a fine vertical section of any articular cartilage in any animal, he will see those cartilage-corpuscles which lie near the attached surface well developed, and containing each from two to six nucleated cells, and near this surface not only do the cells in each corpuscle, but also these latter bodies, tend to arrange themselves perpendicularly to the surface; and when a corpuscle divides, it does so in the same direction. As the object is passed under the glass toward the free surface, he will be struck by a change in this respect; the cells no longer remain in the hollow so constantly perpendicular to one another, and as they divide, they do so as frequently horizontally as in any other direction; at last the divisions and the groupings all tend strongly to the horizontal; the cells themselves become separate, and are flattened in the same direction, till at last they become mere scales, three or four layers of which (Fig. 4), lying close together, form the extreme free edge of the section; that is, the unattached surface of the articular cartilage consists of three or four layers of flattened cells lying quite close together and overlapping each other's edges. This arrangement has caused many observers to believe in the existence of an epithelium. If the superficies of fresh cartilage be shaved off thin with a very sharp knife, the section will indeed have the appearance of a layer of epithelial cells; but if a thin slice through its substance be examined, the gradual horizontal arrangement and flattening of the cells will leave no doubt as to the true structure of its superficies[1] (Fig. 4).

Some observers, Mr. Toynbee among them, found, that in the fœtus vessels run across the cartilage, even into the middle of joints. In neither a fetal hare nor calf, that I had the opportunity of examining, could I dis-

[1] It is not yet quite settled among minute anatomists, whether in fetal development the cartilages ever are covered by a layer of synovial membrane. The subject will be again referred to when the latter structure itself is described. I have thought it better to leave here the text as it stood in my first edition.

cover any such arrangement, nor any trace of it, in a still-born child.[1] Nor have I been able to discover epithelium overlying the cartilaginous surface: what Mr. Bowman took for that structure was, I believe, the superficial layer of cells as above described, which, in the yet unused joint, is finer than when it has been subject to wear and tear. The elucidation is given farther on.

But in early fetal life there is neither bone nor joint, the whole set of structures above enumerated are developed from a cartilaginous basis enclosed in a perichondrium; the mode of this development bears so directly on the relationship of certain parts to the joint and to each other, that some description of the process must be given.

The limb buds of the human fœtus appear at the end of the third week—about the sixth or seventh they are marked externally by shallow grooves for the divisions of the digits and for the different segments. The substance of these buds, now become lappets, is formed from the outer layer of the mesoblast (somatopleura), but they are covered or enveloped by folds of the epiblast. Soon after, but I cannot say how long after the buds appear, a differentiation of the structure takes place, whereby a skeleton, consisting of very soft, jelly-like cartilage, extremely rich in cells, is formed; not all at once—the proximal parts form first, the distal afterward, and the upper limb takes precedence of the lower. This cartilage is simultaneously with, or soon after its formation, covered in with that perichondrium which afterward becomes periosteum. The cartilaginous skeleton is without joints: this must not be taken to mean that a whole limb from trunk to phalanges ever possesses an entire but unjointed skeleton, for cavities, representing future articulations, are formed in the proximal parts, while in the distal ones the cartilaginous skeleton is being built. Although the primordial cartilage is non-articulated, yet at the points where joints are to appear, one may see whitish lines running nearly but not quite through the substance. These, though very visible to a low, are less perceptible to a high power, with transmitted light; for these lines,

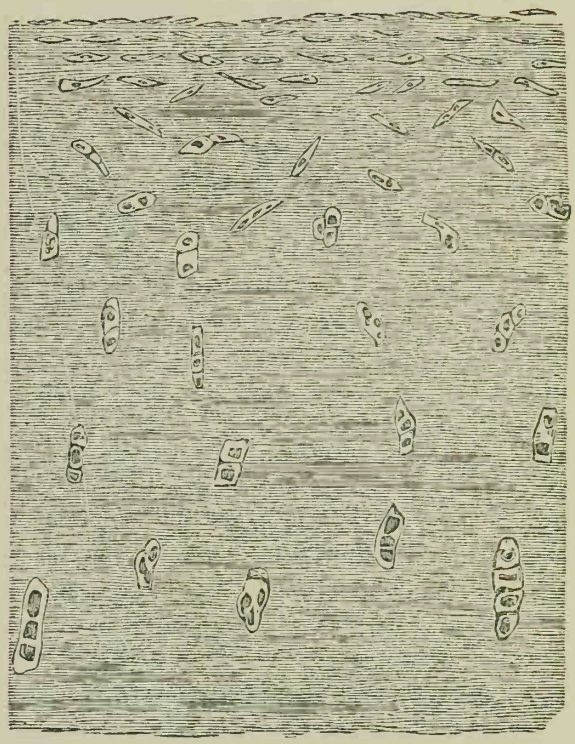

Fig. 4.—Cartilage from human astragalus, magnified about 700 diameters, showing the perpendicular arrangement of corpuscles at the lower part, gradually curving into an oblique, subsequently into a horizontal, position, and drying into scales.

[1] Kölliker could not make out such vessels as Toynbee described. A little further on the development of synovial membrane is described. It seems to me that in some misinterpretation of these appearances lies the clue to what Mr. Toynbee means by "removing the synovial membrane from nearly the entire surface of the articular cartilage of the condyle of the femur, to which it was attached by a considerable layer of cellular tissue" (Philosoph. Trans., 1841, p. 167), and how the cells on the surface have been taken to be epithelium-cells, and also certain views concerning vessels on the surface of the cartilage.

like the rest of the cartilage, are made up of closely packed and identical cells. The structure impresses me as depending upon a different arrangement of the cell-elements, which (they are so densely packed that no absolute rows can be seen) seem aligned transversely to, not, as elsewhere, with, the axis of the bone. These lines foreshadow the place, and I believe also, to a certain extent, the form, of the coming joint. Some time between the fifth and sixth week, first near the trunk and in the upper sooner than in the lower limb, the cells of this white line begin to undergo changes which Luschka calls Verflüssigung (liquefaction). They become, he says, clearer and larger, then disappear and leave a cavity occupied by their *débris* and elaborated fluid.

At this point my investigations diverge from those of other observers. I have only seen this condition of enlarged clear cells once, and that doubtfully in a hare-fœtus of probably five to seven days old, nor do I wish to comment upon Luschka's account of the mode in which the first, the central, part of the cavity is formed ; but this I believe can only apply to quite an early stage of the cleavage ; afterward, at all events, a different action takes place. The space left between the segments of the cartilage is of course, in a cylindrical bone, circular or diskoid in form, but microscopic sections present it as a chink of an elongated oval shape. As we trace the cells from the undisturbed and unaltered cartilage toward the fissure, we find them little changed, perhaps rather flattened ; but toward either edge of the slit—that is, near the circumference of the disk—they gradually elongate more and more, until quite on the edge of the rift they are simply fibre and spindle cells ; the hyaline material (what there is of it) splits up ; the cartilage has here changed into a very fine fibre-tissue. Now if the end of the rift be focussed, one sees that from this extremity the cells and fibres diverge upward and downward, so that opposite the centre of the chink the fibrillation and the trend of the elongating cells run directly out-

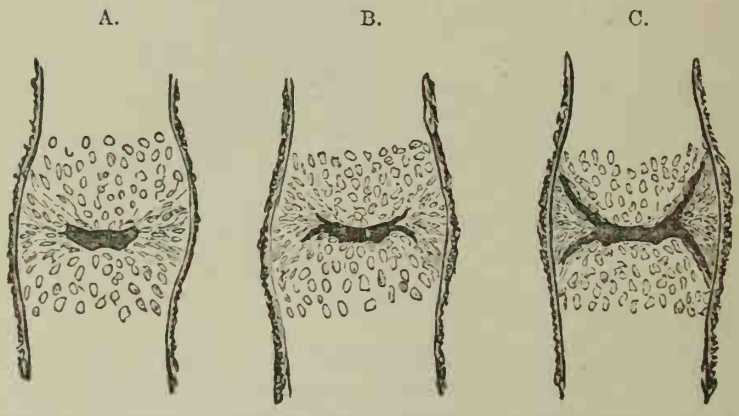

FIG. 5—Diagrammatic development of the synovial membrane. Sections of the joints of little finger (human fœtus), (diagrammatic) : A, early fissuration cells, becoming fusiform, and fibre-cells, arrange themselves in curves from the end of the fissure upward and downward ; B, bifurcating fissure beginning to extend along upper and lower margin of spaces marked by elongating cells ; C, fissure completely bifurcated, has nearly reached perichondrium ; between the forks is a ring of cartilage altered to fibrous tissue thickest in middle, therefore triangular in section ; the thicker portion becomes a synovial fold ; the perichondrium has thickened opposite this ring.

ward to the perichondrium ; above this they sweep in upward, below it in downward, curves (Fig. 5, A). Thus while in the centre the segments of cartilage are separated by a space, they are united at the circumference by a cellulo-fibrous tissue which cannot be said to cover because it is a part, though an altered part of the cartilage. When the fibrous metamorphosis is complete, the fissuration no longer follows a simple straight course across

(Fig. 5, B) the structure, but divides on right and left of section into two branches which follow on upper and lower segment the lines of junction between the fibrous and the cartilaginous tissue ; yet not exactly this line, but one just within the former, so that a very thin film of it is left for a time on the face of the cartilage at its peripheral portion. The result is that this structure, which formerly was cartilage and is now a true fibro-cellular tissue, is left as a ring or rather a short tube round the now sundered limb segments—this ring must by the process of its formation be thickest in the middle, *i.e.*, opposite the fissure of disjunction—also the ends of the tube are not so much attached to, as absolutely growing out of—proceeding from—the cartilage, not merely from its edge but from the more outer parts of its face. Fine sections from a fetal finger or toe between the sixth and seventh month show fibres running from these spots into the tissue lying outside the rift, and also that the two structures are one and the same. At the angle where the rift ends, and progressive absorption is still further separating this fibrous material from the persistent cartilage, little fine tufts or shreds may be seen to spring and project a little way into the cavity. The next phase, that of the still-born infant, shows clearly that the tube of fibro-tissue formed out of the circumferential parts of the cartilage is synovial membrane—the thicker parts of it (opposite the fissure) become synovial folds. The manner in which synovial membrane originates in fibrillar changes of the primordial cartilage, and the mode in which a certain thickness of the altered material is left for a time on the unaltered not-in-contact face of the cartilage, accounts for a still existing divergence of opinion as to whether joint surfaces are at any period of life (fetal or viable) covered by a layer of epithelioid cells.

The figures with which it is attempted to illustrate this description are mere diagrams compounded of the views obtained as the section is passed under the object-glass—no microscope could at the same time show the minutiæ of structure and the whole form. We will leave them and place under a higher power an edge of the rift just inside the perichondrium. The upper edge represents the joint-surface still influenced by the fibrous changes going on. At left of the general mass a still more striated appearance marks the fibres tending to the upper membrane, the synovial, which is seen to be really a part of the cartilage, modified as above described : outside this is the perichondrium, become fibrous capsule, and by further development ligament. It is probable that at certain joints a more complicated plan of rift-formation is followed—for instance, at the temporo-maxillary the first central cavity divides very rapidly into the peripheral cornua—and the resultant wedge-shaped piece (on section) that is left is therefore larger and intrudes further into the chink, and undergoes transformation into fibre-tissue, very partially, remaining at a transition stage between such tissue and cartilage. At the knee, whose cavity is almost completely divided into two by the crucial

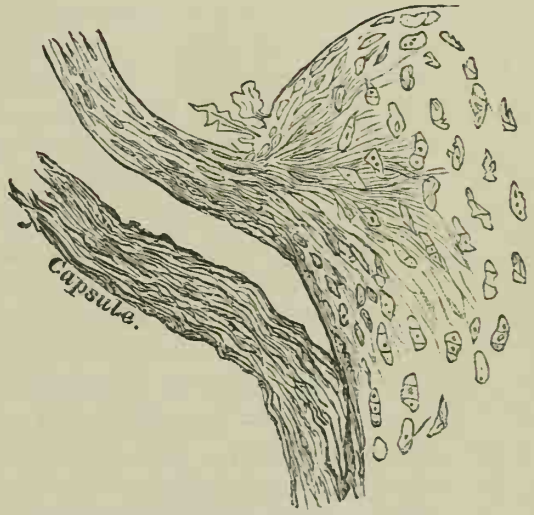

FIG. 6.—Cartilage changing to synovial membrane —fœtus 7th month.

ligaments, it would seem that the primary rift is not single, nor central, but begins by two semilunes, with concavities facing each other ; and that running from the anterior condyloid and popliteal notch of femur and tibia respectively, folds of the perichondrium are prolonged between them. In this joint we have therefore two complications ; one to form the crucial ligaments, another to produce the menisci.

It has been said that as a circumferential layer of cartilage, afterward transformed into synovial tissue, is separated from the primordial structure, certain foliaceous tufts or shreds are left behind, being first visible in the angle of separation. It may here be added, that as absorption models and fines down the central parts of the still too-thick ring, many more such tufts are thus formed out of the pre-existing material. These, in all probability, become afterward synovial fringes—they are sufficiently developed in quite young life ; indeed I have seen them in the premature child, still-born at about the seventh month. It may be that they develop more fully when movement of the joint calls for increased secretion, but they probably are chiefly formed when the thickest part of the ring, opposite the central fissure, begins to be absorbed. They are most abundant on those plicæ, or folds, which, without injury to the structure, admit of motion ; where, therefore, the tissue itself and the peri-synovial structure are loose and own a rich vascular supply. In their simpler form they consist of villous-like folds or saccules of the basement-membrane, each containing an afferent and efferent vessel, but, as far as has yet been traced, no lymphatic. In their further developed form the simple villus sprouts into secondary saccules, which may be sessile, like the segments of certain cactus, *e.g.*, the prickly pear ; or more often are attached by an elongated stalk or petiole. These secondary saccules are always extravascular, but generally contain a watery alkaline fluid, and when secretion is active, are full to bursting (indeed doubtless do often burst) with that liquid. Under a high power and with well-prepared specimens the structure shows itself as a shred of loose areolar tissue, surrounded by cells closely packed in a colloid ground-substance. The cells are not a mere simple coating, they are massed, not in layers, but in irregular heaps several deep. The secondary saccules seem to me a colony of such cells pressed out from the mass, but remaining attached by an inspissated thread of the jelly-like ground-substance. Secretion, more especially of mucin, appears to be the function and *raison d'être* of these singular little excrescences. They are not confined to the synovial membranes of joints, but are also abundant on tendinous sheaths and on bursæ, whether normal, accidental, or morbid.[1]

The peculiar structure and characters of the membrane whose formation we have thus traced is a subject of very considerable importance, nor can, within my limits, full justice be done to the various views which different anatomists hold. Let me first make the way clear by a description of the larger characteristics.

It will have been understood that even in the earliest period of life this structure does not extend over the cartilages of incrustation ; it is therefore never a closed bag into which the bone-ends are pushed, but is com-

[1] I should like, did space allow, to point out here the singular qualities of the middle germinal layer—the richness in cells of all its derivatives—its tendency to form cavities. For instance, the peritoneal, pleural, pericardial, arachnoid—all joint-cavities, sheaths, and bursæ—the chambers of the heart—the lumina of all vessels and lymphatics, the meshes of areolar tissue, are all the offspring of this layer, and out of these last nearly all pathologic cavities arise.

parable to a tube enclosing at either end the articular bone-mass. At the point where the tube-walls come in contact with the cartilage, an intimate relationship between the two structures exists ; this relationship is not mere adhesion, but is continuity of structure. At this spot, termed marginal zone, transition forms of cartilage-cells into areolar tissue-corpuscles, of hyaline substance into fibre-tissue, may be seen. A mere tube thus formed would then be the simplest and crudest idea of this arrangement, but in all joints, parts of the articulating surfaces are not constantly in contact, and these are, during non-contact, overlaid by folds inward of the membrane ; some of these, which we will call synovial folds or plicæ (*not* fringes), contain in their hollow, *i.e.*, outside the cavity, a quantity of fat, so that the plica and fat together form projections which Havers mistook for synovia-secreting glands, whence the name—which may as well be forgotten—of Haversian glands. Folds of the structure likewise exist in parts which cannot thus cover the surfaces of cartilage out of contact, as, for instance, certain puckerings in the neighborhood of the patella, on each side the tendon of the triceps extensor humeri and elsewhere ; they are to allow change of position without tension. The interarticular cartilages or internal ligaments of certain joints cause a complication of the membrane, in order to line those parts while excluding them from the cavity, in the same way as the abdominal viscera are invested by the peritoneum. In some parts, as at the menisci of the knee, such folds are termed ligaments. At the hip, too, a long fold ensheathing an artery is called the round ligament. Certain other reduplications, chiefly at the knee, are subject to the same false nomenclature ; the ligamentum mucosum, soft and fragile as it is, forms a glaring instance.

On all these folds more especially, but also on certain other parts of the membrane, the peculiar villous-like processes which have been already sufficiently described exist. Though each single projection may be termed a villus, they collectively are termed fringes, sometimes tufts ; they increase the secretory power of the organ.

This structure is certainly a somewhat modified serous membrane. It is lined by endothelial cells, which are separated from the underlying very fine areolar tissue and vessels by an extremely delicate membrane.

This statement is made thus concise and isolated, because some doubt has been thrown upon the quality of the membrane, as well as upon its cell-lining, and a whole literature has in Germany been devoted to the discussion of the subject. In 1866, Dr. C. Hüter, of Greifswalde, published [1] a paper, "On the Histology of the Joint Surfaces and Capsules," in which he denied to synovial membranes any right to be classified with serous or mucous membranes, denied that they possessed an epithelial lining, and asserted that their vessels lay naked to the cavity. Now, that Dr. Hüter is a most industrious and deservedly distinguished anatomist and histologist, no one would wish to deny ; I least of all, since on other matters I have had to enter the lists with him.[2] Dr. Hüter obtained his results by treating the inner surface of the membrane with a one per cent. solution of nitrate of silver, whereby he obtained what he calls—"with the exception of the vascular channels, a picture, so confused, whose brown lines and white interspaces are in so variable and uncertain relationship, that any clear comprehension of the view appears impossible." He then interprets the appearances to mean that the synovial membrane has no basement-struc-

[1] Virchow's Archiv, Bd. xxxvi., Heft 1.
[2] Langenbeck's Archiv für klinische Chirurgie, Bd. xxiii., S. 254.

ture, no cell-lining, but an "epithelioid and keratoid arrangement of cells on or mixed with an areolar tissue." But no sooner had this theory been published, than many excellent observers—Schweigger-Seidel,[1] Tillmanns,[2] Albert,[3] and others pointed out that the silver treatment of the synovial membrane is unreliable; that the pictures which Hüter thus obtains are artificial (Kunstprodükte), the result of a chemical union between the albumen of the still-adhering synovia and the nitrate of silver forming albuminate of silver, which is deposited in multiform foliaceous and other shapes upon the membrane, and thus the investigator covered up with his chemical precipitate the structure he was trying to see. Landzert[4] also rejects these images, and shows that Dr. Hüter used a silver solution from four to eight times too strong. It is, however, only fair to state that certain other observers, viz., Böhm,[5] Reyher, and to a less extent Albert, give to Dr. Hüter a partial support. Yet if the minute anatomy of these structures be taken in connection with their origin from the middle germinal layer (mesoblast), I do not see how the histologist can escape the conclusion that the synovial membranes are composed of a fine areolar tissue, plentifully studded with cellular elements, and on which the yellow elastic fibres are especially abundant. Both the yellow and the white elements are arranged as a fine network, the intercussating fibrils meeting at acute angles, so that the meshes of the web are much elongated. Toward the cavity or internal surface much ground-substance cements the network-filaments into continuity, forming a membraniform expansion, whose almost structureless character (save for those filaments) is varied by a free distribution on it of connective-tissue corpuscles, on and near the surface of endothelial cells.[6] There is then no doubt that the inner surface or lining of synovial membranes consists of cells lying in continuity; in some parts, those that are highly stretched, as over the crucial ligaments and near the cartilage on the extension side of the limb, this cell-lining is a single or at most a double layer; in looser parts, and about the fringes, several superimposed layers of cells may be seen.[7] Among these cells are the rootlets of not very numerous lymphatics, and the ramifications of vessels all interwoven with the fine areolar network just described.

The fluid secreted by this structure—"synovia"—is not quite clear; it is thready, contains an uncertain quantity of cells and nuclei, which, when the liquid is placed in a conical glass, slowly subside, so that the lower strata, even in quite normal synovia, are somewhat opalescent. If a little of the fluid be rubbed between the finger and thumb, a sensation is felt of peculiar lubrication, more marked even than when oil is used in a

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[1] Berichte der König. Sächs. Gesellsch. Math.-phys., November 5, 1866.

[2] Archiv für mikroskop. Anat., 1874, Bd. x.

[3] Stricker's Histology, vol. iii., p. 555. New Sydenham Society.

[4] Centralblatt für die Medizin. Wissensch. 1867, p. 371.

[5] Beiträge der normalen und patholog. Anatomie der Gelenken, Inaug. Diss. 1868.

[6] Epithelium can only be produced by the epiblast; hence Hüter, in rejecting an epithelial covering for synovial membranes, is verbally correct; the endothelial cell-layers, however, fully line the sac-surface. Such cells are in all derivatives of the mesoblast sufficiently rich, but in none so plentiful as in joint-cavities, typical offspring of that cavity-producing and cell-generating layer.

[7] I shall not here go into the subject of "keratoid bodies," and of serous canals on the surface (Hüter) or beneath the surface (Landzert); the matter does not appear to me to influence the course of disease. The reader who wishes to follow the matter further may consult the authorities named above, and elsewhere in this chapter. Albert's article, accessible to all, in the Sydenham Society's Translation of Stricker's Histology, will give some idea of the difficulties surrounding this subject.

similar manner, yet synovia contains exceedingly little fatty matter. It owes its lubricating quality apparently to mucin, whose source in the absence of mucous glands is of physiological interest. The reaction of the liquid is alkaline ; now, if we take a piece of epidermis and rub it in a mortar with water, not too strongly alkalized by potash, we obtain a fluid having the physical qualities of synovia, and containing mucin. Hence there is barely room for doubting that the source of synovial mucin is the solution of the endothelial cells in the alkaline fluid secreted by the membrane ; and this view is strengthened by certain observations of Frerichs, who found that while the joints are quiet the synovia contains less than half the quantity of mucin which is found when they are employed. The three analyses are quoted from that author.[1]

SYNOVIA.

	New-born calf.	Stall-fed ox.	Meadow-fed ox.
Water	965.68	969.90	948.54
Solid constituents	34.32	30.10	51.46
Mucin and epithelium	3.26	2.40	5.60
Fatty matters	0.56	0.62	0.76
Albumen and extractive	1.090	15.76	35.12
Salts [2]	1.960	11.32	9.98

The development of vessels in and about the joints is commensurate with the rapidity of the changes above described. Until after the fourth month of fetal life no artery penetrates the joint-ends. At about this period the larger and more proximal epiphyses begin to be channelled with blood-vessels, penetrating inward from the circumference ; but all these stop and form loops some distance from the rift, which becomes afterward joint-cavity, so that at a very early period a distinction is made between that part which is destined to become bone, and that which is to remain non-vascular cartilage. The source whence these epiphysal vessels are derived is a very rich plexus around the epiphyses ; and as the periphery of the cartilage undergoes that fibrillation which changes it into synovial tissue, vessels penetrate largely among the fibres, and thus come to lie at that margin which I have described and depicted (Fig. 6) as changing into a membrane. This network of vessels was named by W. Hunter the *circulus articuli vasculosus*, and was more especially described by Toynbee as lying between the synovial membrane and the cartilage. But this fibrillated layer, described as lying on the cartilaginous surface, is a mere transition phase of joint formation ; it is soon absorbed therefore. The vascular margin on that surface is also transitional, disappearing at a certain period, varying at different joints, but always very shortly after or before birth. The vascular zone and the fibrous surface of the cartilage are temporary steps in the production of synovial membrane. To carry on the nutrition and absorption

[1] Wagner's Handwörterbuch der Physiologie, Bd. iii., Abth. 1, S. 466–7.

[2] The salts are: chloride of sodium, basic phosphates and sulphates, carbonate of lime, and earthy phosphates.

involved in the transformation, vessels just here are necessary ; when those changes are complete, the necessity ceases and the vessels vanish.

It has been a theory in physiology that, as the synovial membrane is a closed sac, it prevents any admission of air, and that therefore the joint-cavity is a vacuum whereby the contact of the articular surfaces is materially assisted, indeed, chiefly produced. Now here some confusion of terms surely exists. A vacuum is a space void of air, or of any substance, fluid or solid. Contact of two surfaces means that between them there is no space. If two smooth and well-fitting surfaces, be they of polished metal or of plate-glass, be pressed together so that there is no space between them, those surfaces are said to be in contact, and they adhere by means of a force called in physics cohesion of contact. Since this cohesion depends upon the pressure of air on the outer surface of these bodies, it is evident if we withdraw air, as in an air-pump, so as to surround them by a vacuum, the cohesion must cease. The vacuum theory of the synovial cavity is therefore an error. It would annihilate that adherence of certain joints' surfaces, such as the hip, which it was intended to explain ; moreover, the experiments whereupon that hypothesis is founded are incompatible and contradictory. These experiments and reasoning whereon this vacuum theory is founded were made by E. Weber, of Bonn, and communicated in *Müller's Archiv*, 1836, p. 54.

"Now, I will give an investigation into the power whereby the head of the thigh is held in juxtaposition with the pelvis. It has been supposed that the limb was fastened to the trunk by the strength of the muscles or ligaments, because such power is the most visible. More careful examination, however, has shown that this is not effected by the power of muscles and ligaments, but by a far less perceptible force, namely, by the pressure of the surrounding air.

"The head of the thigh-bone, which fits air-tight into the globular hollow of the acetabulum, adheres in that cavity as the air-tight piston of a syringe remains in the tube when its upper opening is closed.

"As the quicksilver in a barometer is driven upward by atmospheric pressure, so is the head of the femur, when there is no air above it, driven upward into the acetabulum. I will give shortly the experiments which led to this result.

"*First Experiment.*—The body was brought into such a position that the limb hung freely down. If then the limb hung by the muscles and ligaments, it would fall out when those parts were cut through. I severed the muscles and ligaments, and the limb did not fall ; on the contrary, the joint-surfaces remained in close contact.[1]

"*Second Experiment.*—Admitting that atmospheric pressure holds up the limb, it would fall as soon as air was admitted into the joint-cavity. I bored a hole through the wall of the acetabulum through which air entered—the limb fell, even though the muscles and ligaments had not been divided.

"*Third Experiment.*—Admitting that atmospheric pressure is alone sufficient to support the limb, it should be again supported after having fallen out of the cavity when air was prevented from entering the joint. I replaced the head of the thigh, which had been entirely separated from the body, and then, in order to keep air out of the cavity, I closed the hole

[1] This is as easily accounted for by the cohesion of contact between the cartilaginous surfaces.—R. B.

which had been bored with my finger—the limb was then supported and again fell down as soon as the finger was removed."

Let us examine these experiments a little closely before I relate some of my own. Either the head of the thigh-bone and the acetabulum are in actual contact or they are not. If they be in actual contact, cohesion of contact takes place as between any two smooth surfaces, and a hole bored in any part of those surfaces would only affect that cohesion at the place actually bored. If, on the other hand, they be not in contact, there will either be a vacuum (as far as air is concerned) between them, or there will not. If air be between them, the theory of atmospheric pressure vanishes; if there be no air between them, but a vacuum, Professor Weber did not re-establish that vacuum by merely replacing the head of a thigh-bone in the cavity. Neither on the supposition, therefore, of a vacuum in the joint-cavity, nor on that of intercohesion of surfaces, can all the results of these experiments be explained. I can neither account for the attainment of all these phenomena, nor procure such results; they are incompatible with one another. One source of fallacy may have been that, in boring the hole, Professor Weber unwittingly pushed out the head of the bone with the point of the instrument.

I will now relate some experiments of my own. The first was performed for another purpose, and is more fully related in Chapter XV., in which it appears as Experiment III.

Experiment I.—The subject was placed upon the table on the back; means of actual measurement by needles, fixed one in the thigh the other in the pelvis, were adopted. A weight of 28 lbs. was hung upon a system of three pairs of pulleys fastened to the ankle, thus constituting an extending force of 756 lbs.: no change in the position of the limb or in the measurements was found. A hole was made in the inner wall of the acetabulum: still no change in the position of the limb or measurements. For the other purpose above mentioned a wedge of an inch thickness was driven in between the femur and the acetabulum: when this was removed, the head of the femur kept the same place, namely, separated from the acetabulum. The weight was unfastened, and the head of the femur returned to its normal position with a sound precisely like that produced by disarticulation.[1]

Experiment II., July 6, 1860.—The subject was placed on the back, the weights and pulleys prepared as before, and the same system of measurement adopted. The capsule of the hip was carefully laid bare without puncturing, the tendons of the psoas, and iliacus divided, and weights equal to 35 lbs. were hung on the pulleys—a hole was rapidly bored in the floor of the acetabulum—a minute and a half after this was done, a suction sound was heard, and the head of the femur came out of the cavity. The weights were lifted, and the femur replaced and tightly pressed in the cavity, the finger firmly held over the hole, but whenever any weight was allowed to hang on the thigh the head of the bone fell out, nor could I by any means find the slightest difference whether the finger were held over the hole or not. There occurred, immediately weight came on the thigh, an oozing sound, the sound of squeezing soft moist materials, and the head of the bone fell from the cavity. In this experiment the force exerted was very large.

Experiment III.—The same division of muscles and other dispositions were taken. The force was a stone weight on the three-pair system of pul-

[1] These results are incompatible with those of E. Weber's second experiment, in which the hip (muscles and ligaments being entire) dislocated on boring a hole in the acetabulum.

leys. A hole was bored in the inner floor of the acetabulum and enlarged so that the head of the bone could be felt with the finger. During the work the caput femoris was struck once or twice with the gouge, and the femur would start outward or rotate slightly, but the length was precisely the same, and no separation of the articular surfaces could be found. (In this instance the weight was not sufficient to overcome the cohesion of contact.) I now took off the weight and the cords, and endeavored to dislocate the head of the bone by forcibly twisting the limb in every direction. I most nearly succeeded when the thigh was rotated outward and abducted even beyond the middle line. Still it could not be done until the cotyloid ligament was divided, and then only partially without division of the Y-shaped ligament.

Experiment IV.—All the muscles round the capsule were divided; but the psoas was left entire. The capsule close to the edge of the cotyloid ligament was cut through, leaving that structure entire. This division should have destroyed the machinery for any intrasynovial vacuum, and the head of the bone therefore should have fallen out of the cavity, but I had the greatest difficulty to dislocate the hip, and could only partially succeed without dividing the capsule and the cotyloid ligament.

A curious case occurred to me, which is related at length in an ensuing chapter. A man had an opening into the synovial membrane of the elbow-joint, which, when he alternately bent and straightened the arm, sucked air in and out of the cavity like a pair of bellows. This was a strong man, a sailor, who had a great deal of climbing and other hard work to do, and yet had no discoverable tendency to dislocation. Moreover, in amputation at the hip or in incising the knee-joint for the extraction of false bodies, we do not find any tendency to dislocation, when the synovial membrane is opened.

The whole vacuum theory is untenable; the only fact which at all resembles it is, that cohesion of contact takes place between the joint-surfaces, but this is not a vacuum: a vacuum is a space containing neither air nor other material—the cohesion we speak of takes place when there is *no space* between the parts interested.

The fact is, that every joint has some special means, which hold the bones forming it in close contact, and such aids as atmospheric pressure may yield are but slight in comparison with these. Certainly no man gifted with a tolerable appreciation of cause and effect could regard the enormous power of the muscles passing from the scapula to the tuberosities close to the head of the humerus without considering that their tonicity alone would be of large effect in keeping the head of the bone close against the glenoid cavity. Any one attempting to resect the head of the humerus in the dead subject cannot fail to remark their effects, even as lifeless flesh; and moreover he will find the ligaments and the tendon of the biceps and other parts of the greatest importance. Again, if the rotators of the hips and their direction and attachment be considered, their importance will not be slightly regarded, and besides these the psoas, iliacus, and glutei, in fact every muscle attached to femur and pelvis, have the same effect. Add to this the resistance of the cotyloid ligament, which forms a smaller circle than lies within the cavity, and therefore clips in the bone like a circular clamp, and we have quite enough to account for the difficulty in dislocating the joint.[1] Besides, there is the capsular ligament, which in certain positions takes considerable part in holding the head of the bone in the acetabulum.[1] The

[1] In my Experiment II. the weight hung on the pulleys produced a force sufficient to overcome this ligament and open it out; subsequently, therefore, whether or not air was admitted into the cavity, the head of the bone fell out on the application of the force.

knee, elbow, all the joints in the body, have arrangements either of muscular force or ligamentous resistance for keeping the articular surfaces in contact. By this means only, viz., actual contact of the bones, can any assistance from atmospheric pressure be obtained. A vacuum, *i.e.*, a space unfilled by air between the bones, could not be maintained, the synovial fluid would bubble up as water does in the receiver of an air-pump and destroy the vacuum by filling the space with gas; or the surrounding parts must be forced into such space; or again the bones would be squeezed together, for there is nothing to keep them asunder, and contact, not vacuum, would ensue.

By whatever vessel an articulation be supplied with blood, the fluid all comes from the same source, hence the name of the vessel which brings the blood is unimportant. The reader will remember that all joints are surrounded by circumflex, diverging, or anastomotic arteries, which make the immediate neighborhood very rich in vessels. This arrangement, although no doubt its principal object is to ensure permanence of supply to the distal limb segments, has the effect of affording to increased or to pathologic actions a prompt and large supply of pabulum; while the arterial circulation in the joint itself can hardly be interrupted by any possible position. In the subsynovial tissue the previously ramified vessels form a somewhat close network whose meshes are diagonal and polygonal.[1] In the synovial folds these meshes are peculiarly lengthy, and the capillaries are long and either wavy or curling.

The fringe receives, each tuft of it, a twig often considerable when contrasted with the size of the little organ; the twig soon splits into a number of close anastomosing branches, which afterward unite again to form a vein generally a little larger than the afferent artery. Only the primary villus contains vessels; the addenda or secondary sacculi never do so, save as a pathologic condition.

Nervous Supply.—Every educated anatomist knows what nerves supply the chief joints of the body, yet it will be well, since reference to the subject will often be made, to give here, in tabular form, the nervous supply of different articulations.

Temporo-maxillary joint..	Masseteric and auriculo-temporal of submaxillary nerve.
Shoulder-joint.....	Suprascapular, posterior circumflex, and subscapular nerves.
Elbow-joint.....	The ulnar median and musculo-spiral. (The radio-ulnar junction by interosseous of last named.)
Superior radio-ulnar.....	Same as elbow.
Inferior radio-ulnar.....	Chiefly by posterior interosseous, slightly by median.
Wrist (radio-carpal).....	In front ulnar and median, behind posterior interosseous.
Intercarpal.....	Ganglion on posterior, interosseous behind. The median to outer; ulnar to inner side in front.

[1] I have never been able, in either fetal or adult joints, to see a vessel lying bare on the synovial membrane. Hüter insists on their lying "naked on the surface." It is only fair to say that Reyher (loc. cit.) makes a statement which seems to confirm this idea.

Carpo-metatarsal	Same.
Metat. phalan. of thumb	Cutaneous digital, or from branches for interossei, median and radial.
Phalangeals	Digital branches.
Sacro-iliac	1. Superior gluteal. 2. From junction of lumbo-sacro, and 1st sacral. 3. External branches of 1st and 2d posterior sacral nerves to back. 4. Obturator, probable (Hilton).
Hip	From lumbar plexus. Anterior crural, obturator (anterior part). Accessory obturator when present.—From sacral plexus. Nerve to quadratus, several branches from great sciatic, and from lower part of the plexus.
Knee	Internal popliteal and external popliteal; these accompany the articular arteries nerve to vastus internus, and to vastus externus; obturator to back of joint.
Ankle	Internal saphenous. External branch of anterior tibial.
Tarsal joints, and tarso-metatarsal	Anterior tibial, or one of plantar nerves.
Phalangeal joints	Digital branches.

The distribution of the nerve-twigs upon the synovial membrane is not by an even retiform arrangement of meshes spreading upon or under the surface; indeed, the small size of the twigs entering the joint would be insufficient for such purpose, and shows that the tissues are not very rich in sensitive supply. These twigs split up and take long sinuous courses; then subdivide, and, curling round, terminate in minute plexuses, forming little spots just beneath the inner membrane. The arrangement presents, therefore, a pattern as of tendrils and little leaflets—not unlike the conventionalized jasmine or pea-blossom in some of Morris's wall-papers. Certain parts of the synovial tissue seem pretty rich in these plexus-spots, as, for instance, at the outer and front part of the shoulders, the back of the femoral condyles; others are nearly destitute of nerves.

A peculiarity of nervous supply pertains at the carpal joint, which, as far as is yet known, has no analogue elsewhere, the posterior interosseous nerve ends in a gangliform swelling, twigs from which supply the articulations of these small bones. A ganglionic joint-supply is found nowhere else; even those filaments which run from the interosseous nerve to the wrist-joint branch off from the trunk above the ganglion.

Although a scant supply of fine nerve-filaments may be seen in ligaments, no nerve has as yet been found in normal articular cartilage.

Mr. Hilton ("On Pain and Rest") has pointed out that every joint is supplied by branches from the nerves of the muscles moving the articulation, and from those that supply the skin over the joint. And this is no doubt true; witness the supply of the temporo-maxillary joint by the masseteric, and auriculo-temporal, of the shoulder by the supra-subscapular and circumflex, etc. At the knee is a remarkable plexus, about and above the patella, lying chiefly at the inner part of the front aspect of the limb, formed by branches from the saphenous, the obturator, and from the nerves to both vasti. In a physiological point of view the results of such arrangement are beautiful and interesting, and the therapeutic influence of great importance.

To inject with colored fluids the lymphatics of the synovial membrane is extremely difficult; and yet there is no doubt that a plentiful system of these minute tubes must exist, because very shortly after filling a joint with such liquids, the coloring material is found in the intra-muscular lymph-canals of the upper limb-segment. It has hitherto proved impossible to demonstrate, on or underlying the synovial surface, a fine network of lymphatic capillaries provided with stomata, such as Klein and others have shown to exist on the surface of other serous membranes.[1] The most superficial lymphatics are immediately beneath the endothelium, but sometimes the smallest blood-capillaries lie over the lymph-channels, *i.e.*, between them and the endothelium. These finest lymph-tubes sink then deeper into the perisynovial tissue, where they are generally exceedingly numerous, surround the blood-vessels with a fine network, and may be followed into the minutest spaces of the connective tissue. The difficulty, or rather, up to the present time, the impossibility of obtaining the colored network just beneath the surface, as for instance on the *centrum tendineum*, but merely colored maculæ, cannot at present be explained; but that there is a free communication between the fine endothelium-lined lymph-canals of the synovial surface and those lying a little deeper is evident from the fact that the coloring material passes so quickly to the latter; sometimes so rapidly that the surface loses, even while being examined, its coloration, while the deeper parts become more markedly stained. Perhaps this fact may in part account for the difficulty of demonstrating a surface network, and the diffuse spots seem due to the absorptive activity of the endothelial lining. The fringes never contain a lymphatic, nor are there any in the cartilages. The lymph-channels of the synovial membrane pass along the intermuscular spaces, never into the bone of the limb.

The material which surrounds and supports the *intima* of the synovial membrane is areolar tissue, whose structure need not be here described.[2] I would merely point out that the inner portions are formed chiefly of the yellow or elastic fibres with plentiful cement material, and that as portions farther and farther from the joint be examined, more and more white matter predominates, until the capsule or capsular ligament is reached, when a structure, consisting almost entirely of white tissue, is found. Thus nowhere is a ligament isolated in the sense that a tendon is isolated. We can, it is true, with the scalpel define and demonstrate its edge and boundaries, but this is done at the expense of innumerable bonds and interweavings that have been cut away. The tissue of ligament, be it capsular, lateral, or otherwise, is at a thousand points continuous with the perisynovial tissues, and always in the process of disease shares, though slowly, the same fate.

Let us once more turn to developmental history. The ligaments are formed from the periosteum (perichondrium), which consists of a fibrous layer (white tissue) closely bound to the subjacent parts by a softer, more flexible, vascular layer (yellow tissue). As the cartilage in the process of joint-formation changes on each side of the cleft of separation into a fine synovial structure, the adherence between that altered tissue and the delicate vascular layer of periosteum still continues, while further out that layer

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[1] Hüter ascribes to the synovial membranes almost total absence of lymphatics; the account in the text is chiefly taken from Landzert, who has not as yet completed his promised work.

[2] Quain's Anatomy, vol. ii., p. 52; Quekett's Histological Catalogue, Todd and Bowman's Physiology, and many other works, may be consulted.

maintains its continuity with the denser fibrous stratum. Thus we have an uninterrupted gradation from the outer surface of the ligament to the fine cell-pervaded intima of the joint-sac itself. But the ligament, when first formed, is a tube running from bone to bone, and in certain joints it never abrogates this form, as at the hip and shoulder, but the movements of the ginglymoid articulations are such, that the separation of certain points of the two bones at the back and front aspects is very considerable, while at the sides certain other spots of the bones alter their distance from each other very slightly. During the earlier phases of life, while the fibrous structures are very soft, those which lie at the place of greatest motion are stretched, changed, and lack development; while those at places which movement does not disturb, grow and thicken to very strong bands.

I would, in conclusion, point out the intimate relation to each other of all parts which in adults we know, in their sum as a joint—bone-cartilage, synovial, perisynovial tissues and ligaments—are all of one parentage. The cartilage and perichondrium of the fœtus begin to change before birth into these various structures. But few joints are complete at birth; the imperfect state of some articulations, even during some years of viable life, is an important consideration.

CHAPTER II.

ACUTE SYNOVITIS.

Few if any inflammations in the human body own so many causes as acute synovitis. Overexertion, a strain, a wound, rheumatic or gouty diathesis; infection of the blood by syphilis, by exanthematous disease, by pus from a wound or from a secreting mucous surface, whether urethra, vagina, or probably also uterus, are all occasional causes of that malady. The nomenclature may take, therefore, a different adjective, descriptive of the predisposing disease. Thus we have acute, traumatic, rheumatic, gouty, and other forms of synovitis, etc. Besides this, names are applied to indicate the sort of effusion caused by the inflammation: thus, there are such names as serous, and as membranous, or, as I prefer to call it, dry synovitis (*synovitis sicca*); suppurative and purulent synovitis; and even some writers have added sanguinolent synovitis, an unnecessary term that I shall not employ. From the present chapter all the more constitutional forms of the malady, such as gouty, rheumatic, and pyæmic synovitis, will be excluded. Moreover, although suppurative synovitis is occasionally a sequela of the simple malady, and may be considered as only a different degree of the same disease, therefore logically coming under the same heading, yet it is so different in its gravity, results, and treatment, that I deem it more practical to place it altogether in a different chapter.

Simple Synovitis is a term which denotes an inflammation arising from no preponderating cachexia. A malady so named may be lit up by injury or exposure, but not by gout, syphilis, pyæmia, or other constitutional condition. It is much more common in men than women, and occurs chiefly between the ages of fifteen and thirty-five; that is to say, the sex and the age most exposed to vicissitudes of temperature and to muscular overexertion, the age also of least prudence is the most prone to suffer from the effects of those peculiarities. It is much more difficult to account for the extreme partiality which this disease shows for the knee-joint. When the cause is exposure, a joint so superficial as the knee will evidently be peculiarly open to attack. The same articulation is more obnoxious to injury, partly from the almost subcutaneous position of its synovial membrane, partly because of its situation between two such long levers as the femur and tibia, laden with the whole weight of the body. But other conditions, such as pyæmia, rarely leave the knee unaffected, and nearly always select that joint, if but one only be attacked. The form of that malady termed gonorrhœal very rarely indeed spares the knees, and frequently attacks them to the exclusion of all others. I should suppose that the large extent and the complication of its synovial membrane must be accepted as the sufficient cause of this marked preference.

Opportunities of examining pathologically into the early changes constituting simple synovitis are extremely rare. One, however, occurred to me some years ago, and another quite recently.

Case I.—A man, aged forty years, was brought to St. Thomas's Hospital, having fallen a considerable height through a skylight, and received an injury to the head.

He was bleeding from the right ear, had a severe bruise over the forehead, and was insensible; he was taken at once to the wards. The next day, also, he remained insensible; but it was found that the left knee was hot and fluctuating, not red, having all the local symptoms of acute synovitis, hereafter to be more minutely described. The same conditions continued for four days; on the fifth morning he died.

More than sufficient injury to account for death was found in the head by the gentleman who examined it. I made a careful observation of the knee.

The joint contained about an ounce and a half of synovia, which was slightly turbid, opalescent, and in which floated shreds of false membrane, some semitransparent, others opaque and white; these latter being more evidently fibrous; one of the shreds was loosely attached by one end to the synovial membrane, the rest floating freely in the fluid. The whole membrane was intensely injected, the vessels not being on the surface, but as though visible through a film; in some parts the injection was much more violent than in others; the deepest in color were the fringes around the patella, the so-called alar ligaments, and the subcrureal cul-de-sac; in many spots of these parts were actual extravasations, which, again, were not on the surface, but beneath a fine film. In the less injected parts of the membrane long tortuous vessels could be distinctly traced. The surface of the membrane itself was finely roughened; on holding it up and looking toward the light over the surface it was seen to be covered with papilla-like or velvety elevations; it looked like the surface of the duodenum when the valvulæ conniventes are straightened out. The membrane was easily torn, and very easily stripped from the underlying tissue, which was highly injected and infiltrated by a turbid serum.

On the inner condyle of the femur was a spot as large as a sixpence, whence the cartilage had entirely disappeared; the edges of the ulcer were perfectly smooth, sharp, and clean. The rest of the cartilage was entirely healthy.

Case II.—E. M., aged forty-five years, was admitted into Charing Cross Hospital, July 27, 1875, having the right limb greatly swollen from phlebitic cellulitis—the chief enlargement culminating at the knee; he had also severe bronchitis, tympanitis, and was partially comatose from collapse. Mr. Watkins, of King William Street, gave me the following history: Six days before death he had, in some liquor-fight, received a kick on the knee. Next day the joint was seen by Mr. Watkins to be greatly swollen. The man neglected to come into hospital or to submit to treatment until nearly moribund. The important point is that about one hundred and thirty hours before death the knee was hurt, and that twelve hours subsequent to injury it was seen inflamed and greatly swollen.

At the post-mortem examination the joint was found to contain an ounce and a half (as near as could be measured) of synovia, so deeply tinged with blood as to be the color of claret and water, mixed half and half; it was but very slightly turbid, in it floated a number of blood-stained gelatinous masses, from the size of small pins'-heads to that of dried peas. The membrane itself was intensely injected, so as to have a nearly uniform deep claret-colored hue, in which separate vessels could with difficulty be perceived; this coloring was a little more intense at the sides of the patella; and on the inner side a line of darker coloring ran from the knee-cap back-

ward about an inch opposite to the junction of the bones. On the crucial ligaments the redness was decidedly less. I found no appearance of a wreath-like vascularity round the edges of the cartilages, probably because everywhere hyperæmia was so intense, but the folds were all increased in bulk; owing apparently to their lumen being full of fluid, they lapped over the non-in-contact part of the cartilage, but did not intrude between the bones. The hyperæmia was not immediately on the surface, but lay beneath a transparent but somewhat clouded film which, with the finger-tip, could be moved over the vessels; this laxity appeared also to depend on a layer of fluid just beneath the basement-membrane. The surface of the membrane, though it had lost its usual polish, did not look, in this mode of viewing it, rough. I can only describe its appearance by comparing it to a mirror that had been breathed upon. A portion near the patella and a piece of the mucous ligament were carefully removed and placed in water, when a velvety irregular pile appeared, produced by floating up from the surface of hypertrophied fringes. Placed in a cell under a lens, a beautiful arborescent growth was seen formed by foliaceous twigs and branchings like a very fine moss. Other parts similarly examined showed only here increased thickness of all growth, there abrasion-like absence of all covering, as though the endothelium had fallen away, which indeed was probably the case. The surface of the cartilages was considerably blood-stained, but this stain was so superficial that its thickness on the edge of a transverse section could only be seen with a strong lens.

The cellular tissue and other parts around the joint and on the limb generally were inflamed, congested, and infiltrated with serum. No occlusion of veins was found, but the larger vessels, and some of the smaller ones, were filled with thick though still liquid blood.

These autopsies represent early stages, and both about the same phase of the disease, much more severe in the one than in the other; yet the condition found does not represent the commencement of synovitis; a condition so little likely to be seen in the human body that several experiments have been made on animals to supplement the deficiency by M. Bouley, M. Rey, M. Richet, and others, some of which will be more fully described in the sequel. From the above cases, and from these experiments, we are able to follow with great certitude and succinctness the course of the disease, confining ourselves at present to simple synovitis not passing into suppuration.

The first step of the inflammatory act is hyperæmia of the subsynovial tissue, accompanied, or closely followed, by rapid secretion of synovia into the cavity of the joint. This hyperæmia is most marked wherever the tissue is abundant and lax, as, for instance, on the synovial folds, or the Haversian glands (fat-pads), etc. On the other hand, where it is tightly stretched or closely applied to subjacent parts, the redness is less pronounced. In most cases of acute character repletion of the vessels relieves itself by extravasation into the joint-cavity, and also beneath the basement-membrane, leaving blots of chemosis chiefly in the laxer portions; such extravasations are rarely if ever absent in cases arising from injury. The hyperæmia is always followed by enlargement of the villous-like fringes of the synovial membrane. At first this increase is merely due to their becoming soaked in the effused liquids; but after the inflammation has lasted a certain time, they really increase in size; their already foliaceous form becomes more and more arborescent; they soon after begin to invade the surface of the cartilage. This vegetation of the fringes is, how-

ever, less marked in acute serous synovitis than in certain other maladies, and it will be again referred to when we treat of those conditions. Accompanying these changes is great proliferation of the tissue-cells; the product is in great part pushed or washed into the joint-cavity, rendering the fluid opalescent or milky. In the severest cases portions of synovial basement-membrane, denuded of their cell-covering, are invested with fibrinous concreta, formed either on the surface of the membrane itself, or deposited from the fluid of the cavity.

This fluid varies in different cases very much in quantity, also in consistency and color, according as blood, fibrin, or cells of different sorts and amount are mingled with it. This variation is encountered, as I have frequently observed, not only in different cases, but also in the same cases in different phases of the malady. When rapidly accumulated, the fluid is thinner than normal synovia, unless inflammation run very high; and if the puncture for evacuation have been made early, the liquid will be found to be transparent. A later puncture, or what comes to much the same thing, puncture at the same time in a more acute case—will evacuate an opalescent or even a milky fluid, and this opalescence increases (the disease continuing) the later the fluid is drawn off, later I mean with regard to the phase of the inflammation rather than to the absolute number of days. When the admixture of leucocytes is considerable, so that the fluid is milky or creamy, I am in the habit of calling it "puro-synovia."

If this fluid be allowed to stand for an hour or more in a conical glass, the particles producing the opalescence gradually sink, leaving a clear transparent liquid above, a milky and thicker one below. The fact is of so great importance in the pathological history of these maladies, that it is desirable in this place to draw especial attention to it.

In some cases the fluid will be found stained with blood to different hues, from a light pink to blood color. In 1862 I punctured, in consecutive weeks, the knees of two men which were greatly inflamed from injury; the fluid was as red as blood fresh from an artery. The experience which I have since derived from the puncture of joints is, that considerable hemorrhage generally occurs in synovitis rapidly following injury; but is less marked as well as less usual after slight injuries, and idiopathic forms of the malady.[1] It seldom happens that the blood coagulates in the cavity of a joint, *i.e.*, when once mingled with synovia, but it probably does so occasionally; more frequent is the adherence of a clot to the spot from which it was slowly poured out.

On the other hand, an effusion, free or nearly free of blood, may be rich in fibrin, some of which may coagulate into lumps that may adhere by mere stickiness to any fortuitous part of the surface with which they come in contact; probably also, as in the case of blood-fibrin, may remain adherent to the part which secreted it. Sometimes, but more rarely, the effusion, small in quantity, is extremely rich in fibrin, which, coagulating with more or less rapidity and adhering to all sides of the synovial sac, lines it with a tough material, not unlike the false membrane of certain diseases of the mucous surfaces. Such cases in their furthest development constitute synovitis sicca,[2] and in a less extreme form a transition between the serous and the dry synovitis. The student of joint diseases must, however, be warned against assuming that the gelatinous little

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[1] Cases of tapping are related in the sequel.

[2] The Arthro-meningitis cruposa of Volkmann.

lumps which are so constantly found in the fluid of synovitis are fibrin. On the contrary, those that are quite transparent, or at the most opalescent, consist merely of a conglomeration of cells produced by migration or proliferation from the synovial surface. These cells at first float singly, but soon, by a universal law of attraction, run together. Most of these glomeruli undergo fatty degeneration, and disappear; others fall upon and adhere to the synovial membrane, where they may either dissolve or undergo some form of development.

The varieties just described in the constitution of the fluid are very important. Let me recapitulate. It may be normal in all but amount, or it may be abnormally thin; sanguinolent and transparent, or both blood-stained and opalescent; it is in some cases (not blood-stained) slightly opalescent and mixed with fibrinous floating concreta, or the amount of fibrin may be greater, when the concreta are larger, and some of it solidifies on a rod shaken freely in the liquid. Lastly, the fluid may be milky, even creamy, from the admixture of leucocytes, indeed so turbid and white as to resemble, more nearly than synovia, the sort of pus which is secreted by a mucous membrane in a state of catarrhal irritation.

These changes within the joint are accompanied by hyperæmia, inflammation and thickening of, with effusion into the surrounding tissues. Such action occupies in different cases a variable thickness of the peri-articular tissues, as measured from the basement-membrane outward. Moreover, these tissues will, in certain cases, be chiefly infiltrated with the serous, in others with the cellular and fibrinous constituents of the blood; so that not only inside but also outside the joint-bag the inflammation will tend more toward the dry or fibrous form in some cases, while in others it is more distinctly and markedly serous, and between these two extremes every imaginable phase and shade of difference exist.

The microscopic appearances which tally with the above changes are as follows: The synovial cavity, its surface, the tissue itself, and a certain thickness of the peri-articular structures, are soaked with fluid effusion, which also somewhat infiltrates the villi and fringes. The same structures are also filled with a new cell-growth,[1] the parts of which that lie outside the joint in the fibrous capsule and ligaments at first soften, and loosen those strictures by separating and partially absorbing their fibres, thus ultimately leading either to their induration and thickening, or to their destruction, according to the ulterior changes of the cells themselves. The cell-progeny which springs from the deeper, the inner surface of the basement-membrane, is in part washed into the fluid contents of the sac; in part thickens and increases the villous fringes; in part and in certain cases forms a patch or patches of false membrane on those spots of the synovial

[1] The first edition of this work was published when the doctrine of parenchymatous inflammation, the Cellular Pathology of Virchow, first made its appearance in Germany, and I felt myself obliged to enter fully into this subject in order to expound more clearly my views—since everywhere adopted—concerning the large part that granulation plays in joint disease. Since that time the doctrine of the proliferation of tissue-cells has been cast into the shade by the discovery of migratory leucocytes—a very important factor in the process of inflammation—but not, as has been too readily assumed, the whole process. Tissue vegetation has been too much ignored. I am quite certain that much of the inflammatory cell-progeny is the result of that action even in acute inflammation, and I have strong grounds for believing that in chronic inflammation very little migration of leucocytes takes place. I wish it then to be understood that when using the terms "cell-progeny" or "cell-proliferation," the parentage of the cell-growth is not either way affirmed, except in those instances where it is especially traced.

surface, which, being abraded of the normal endothelial cells, would otherwise be bare. Between these two new cell-growths, inside and outside the *intima synovialis*, that structure itself becomes obscured and often lost. If the process go far enough, the joint-cavity is now surrounded, not by the complicated structures described in the last chapter, but simply by more or less altered and inflammatory tissue, having a nodular, uneven inner surface, and containing fluids of a sanguinolent, opalescent, turbid, purulent, or fibrinous character.

At some part of this stage of effusion and thickening most cases of simple synovitis stop, either checked by treatment or by the natural limits of the disease. The cartilages have not been affected, for they reply more slowly to an irritation than do textures which are supplied with blood-vessels and nerves; the ligaments in far advanced instances are somewhat altered, being thickened, and the fibres separated. The above-described processes diminish first in intensity, then cease; retrogression then commences, the engorgement disappears, and the superabundant fluid in the joint decreases in quantity. The cell-broods shrivel, fall into fatty degeneration, are in part absorbed and partly converted into imperfect areolar tissue, which remains like an old scar, causing some thickening, with loss of pliability and of elasticity in the peri-articular tissues. If the amount of fluid poured forth during the disease have been large, it will have caused such distention of the synovial membrane that the latter will perhaps never, and certainly only after a lapse of time, regain its normal dimensions, and in its cavity the synovia will remain rather more abundant than natural. From these causes the joint does not recover its original size; if it be superficial, the increase will be plainly perceptible; moreover it will feel stiff and weak for years after the disease, being extremely liable to renewed attacks of inflammation. It may also be left subject to painful sensations which seem to depend on, or at least to be greatly influenced by every change of weather, and which, unless the patient be advanced in life or have some constitutional taint, gradually disappear. Any diathesis, be it strumous, rheumatic, gouty or otherwise, will, in all probability, cause an attack of acute synovitis to prolong itself into subacute or chronic malady, marked by the systemic peculiarity. These will be considered in future chapters.

If, however, a simple acute synovitis do not thus stop, it may assume, or many cases from their very onset begin with, a freer emigration and proliferation on and near the synovial surface, which impart to the secreted liquid a very different character through the admixture of leucocytes, or tissue-cell progeny. There is no difference between these forms of cell and the pus-cell, no clearly marked distinction between synovia charged as above, and the same fluid mingled with a certain amount of pus, or in its further advanced forms consisting simply of pus. The synovial membrane was in our first chapter shown to secrete normally a fluid containing mucin derived from the shed endothelium cells. An increase of this shedding and a decreased rapidity of dissolution soon render their accumulation in the fluid well marked by an opalescence and turbidity which approximates the liquid more and more to muco-pus or indeed to pus. We all know how difficult, or rather, in many cases, how impossible it is to distinguish a mucous from a purulent leucorrhœa; how the secretion, not having characters distinctive one way or the other, is named from both "muco-pus," the result, it is true, of an inflammation, but of an inflammation which affects the mere surface.

Identical action takes place on the surface of the synovial membrane, producing in the joint the accumulation of a fluid which cannot be distin-

guished from pus, except by the fact that it usually, unless in the most developed forms, is more lubricatory and thready. The results of very many investigations into the quality and nature of fluids secreted during synovitis convince me that opalescence, milkiness, even creamy puriform conditions, are frequent characteristics of such liquids, often, unless examined, quite unsuspected. Generally, as the inflammation subsides, fresh contribution of cells from the surface ceases; those already in the cavity fall into fatty, mucoid, or granular degeneration and disappear; the fluid resumes its ordinary clear synovial character; the disease is cured.

But, on the other hand, if the inflammation continue, the constant fresh cell-formation renders the secretion thicker, more frankly puriform and larger in bulk, setting up a tension of itself a source of danger, while the accumulation of pus in a cavity (it cannot, as in mucous tubes, flow away) evidently may involve grave consequences. This malady, which I would call purulent synovitis, differs from suppurative synovitis in the mere surface nature of the inflammation and pus-production. It is a far less grave condition, being a mere exaggeration produced by some irritation of the normal secretion by the surface. While a pus-production in the depths, in the substance of the tissues, is altogether abnormal, and only possible when some destruction has occurred, nevertheless when (and this is not very common) a simple changes to a suppurative synovitis, it is by the route just indicated; firstly, the secreted fluid becomes more and more distinctly puriform; tension arises, and pus-formation passes deeper and deeper among the tissues.

Such are the changes which take place in the joint itself, and in the immediate neighborhood. A few words remain to be said concerning the effect of joint-inflammation on adjacent parts, chiefly on the muscles, viz., certain almost definite contractions and wastings. Whenever a synovitis, even though not severe, arises, the limb-segment below assumes a certain position, which, save in a very few exceptional instances, is invariable for each articulation, while wasting commences. The wasting is not attributable to mere rest, since an equal amount of immobility in diseases unconnected with joints does not produce commensurate atrophy. As a very general rule, the flexors are contracted,[1] the extensors relaxed, the flexors waste but slowly and only after a time; the extensors quickly and at once. These conditions are better exemplified on the joints of the lower than of the upper extremity; for instance, at the hip the ilio-psoas rectus and tensor vaginæ femoris are felt during inflammation to be tense and hard, the gluteus maximus flabby and pendulous; this condition, together with drooping of the nates, being one of the commonly known early symptoms, and in a very little time the buttock of that side becomes flat and thin. Again, at the knee, while the leg bends and the hamstrings are felt to be cordy and tight, the quadriceps extensor is flaccid, and wastes so quickly that two or three days after the commencement of a synovitis the outline of the lower third of the thigh, looked at from the side, instead of being rounded or full, is an absolute concavity, a hollow. We have seen that there is a distinct and evident connection between the innervation of muscles and of joints; but anatomy here fails to explain why inflammation of the latter should affect the former so differently, why it should produce tension of

[1] In the commencement of joint-disease the contraction is active. I must refer to Chapters V. and XIX. for the distinction between this and a passive state, called by me "contracture."

one set, and almost annul even the normal tonic contractility of the other. At present we must accept the fact without the explanation ; nor must it ever be overlooked, for muscular actions, irregular and abnormal, play, as we shall see, a great part in joint-disease, and the prevention of their effects takes a large portion of the treatment.

A form of disease termed dry synovitis is of very obscure etiology. It never, so far as I know, attacks other joints than the knee, in which I have seen three cases of such malady ; but it may be that some of the very painful affections of the adult hip are of the same sort ; the fluid effusion in these cases, being transitory, while pain lasts a long time, and anchylosis, true or fibrous, according to the duration of the malady, would lead to such supposition gathered simply from analogy, not from direct anatomical examination, for which no opportunity has offered itself. It appears to me probable that the dry form of disease commences as a simple synovitis with unusually fibrogenous effusion, that fluid parts become rapidly absorbed, and coagulation takes place over the inner lining of the joint-sac. We shall see that there is reason to believe that a flocculus or blood-clot, if it chance to be deposited on the inner surface of the membrane, causes the spot to which it adheres to be the seat of severe pain, which in character is like that of dry synovitis, but limited to a small point, and therefore bearable.

Symptoms.—The symptoms of an acute inflammatory disease of a joint are those of inflammation, redness, heat, pain, swelling ; modified more or less by the part attacked, as also by the mode or class of inflammation.

Thus, redness of the joint is by no means a necessary accompaniment of synovitis. In the simple form of the disease it is usually absent ; in the gonorrhœal, so conspicuously absent that I have often believed the joint to look abnormally pale. In pyæmic conditions also there is generally no redness, but not unfrequently a localized blush with sharply defined edges will be seen somewhere on the swollen part, usually over, and in the direction of absorbents and of veins. On the other hand, rheumatic and gouty synovitis is accompanied by pretty considerable rubefaction. It is therefore evident that this symptom stands in no clear ratio with the intensity of the disease.

Increase of temperature always accompanies acute inflammation of joints. It is more marked, or at least more easily demonstrated, the more superficial be the articulation ; at the knee more readily than at the hip, at the elbow than at the shoulder. The mode in which I have obtained my results is as follows : for some half hour, and frequently much longer, before taking temperatures, I have carefully placed the two knees, or two other joints in the same conditions as regards covering : I have then chosen the same spot in each, laid a thermometer first on the sound side, covering it with a thick coating of cotton-wool—retained in place by the fingers—the same has then been done with the diseased side.

A joint affected by acute rheumatism has often a very high absolute temperature ; but not relatively to that of the other limb, since the whole body is hot. On the other hand, a gouty toe will be very much hotter than that of the other side, even as much as 3.2°, as in one of my cases. The gonorrhœal and pyæmic joints show but little or no perceptible increase of heat. The rise of temperature in simple synovitis, according to its acuity, is from 1.5° to 2.4°. Of suppurative synovitis I can give but one case since I began the thermometric observations ; the temperature here was 3.2°. It should be noticed that in cases, such as gonorrhœal, pyæmic, rheumatic, in which the thermometer will mark only a fractional rise, the sense to the hand is frequently that of very considerable heat. The phenomenon is dif-

ficult to account for; it probably is caused by some difference in the surface-texture, perhaps some electric change may be involved.

Pain, although always present in acute synovitis, varies, like the two symptoms already described, with the sort of inflammation quite as much or more than with the degree—gouty, suppurative, rheumatic, gonorrhœal, simple, is the order of succession in degrees of pain, presupposing, of course, similar intensity of disease as nearly as can be estimated. The form of malady also governs the sort of pain: the gouty and the rheumatic pain are in themselves peculiar. The bursting and throbbing sensation of commencing suppuration is well known, and most of us have experienced, at least in some small degree, the bruised sort of feeling and the helpless sensation of limb produced by a simple synovitis. With pain, properly so called, tenderness is closely combined; badly inflamed joints are tender all over, if less severely affected they have special points on which moderate pressure causes pain, while the rest of the articulation is not thus sensitive. These points are more distinctly marked, and are of more importance in subacute and chronic disease, therefore only a few, the most striking, need be mentioned here. The point of tenderness at the knee is on the front of the internal condyle, about a finger's breadth from the inner margin of the patella. At the hip are two spots; one behind the great trochanter, one a little outside the ramus of the ischium, about the posterior edge of the gracilis origin. At the elbow a point at the back of the joint between the head of the radius and the humerus. At the ankle a place in front of the outer malleolus, about where the peroneus tertus tendon crosses the joint.

Occasionally a particular spot of the synovial membrane will be both very painful and tender, and these symptoms will be peculiarly obstinate. These spots are not constant like those just indicated, but are here in one case, there in another; their localization appears quite accidental. Such occurrences are attributed by Volkmann to deposition on the synovial membrane of a fibrin-clot. This is very probably the correct interpretation, but we have no direct anatomical proof of its truth.

Swelling is produced by two causes, viz., by hyperæmia of and effusion of fluid into the peri-articular tissues, and by accumulation of liquids within the joint-cavity. The former of these predominates in some, the latter in other forms of malady. Thus in most cases of acute gout, rheumatism, and pyæmic synovitis, the peri-articular very much masks the intra-articular swelling. Acute sero-synovitis, whether brought on by injury or exposure to cold, is remarkable for the preponderance of enlargement from liquid effusion into the joint-bag itself; indeed, so marked is this peculiarity that the name of acute hydrops articuli has sometimes been applied to the malady.[1] The sort of joint enlargement produced by the two causes is very different: the purely peri-articular swelling is simply shapeless, or it may deform the outline of the joint to one side or the other; it does not fluctuate, but has a tendency to pit. The intra-articular, expanding from within, presses the synovial membrane outward; and, while approaching the globular shape, is nevertheless confined within the boundaries of that bag, takes more or less its shape, and since the sac is crossed and bound down at different points by ligaments, muscular attachments, and similar structures, it becomes marked in those localities by depressions and constrictions which give a peculiar character to the tumefaction. The shape then of a joint thus affected is, to a certain extent, the form of that joint reversed;

[1] The term is bad, because although the presence of fluid may be the most prominent it is not the most essential symptom, which is inflammation.

normally those various parts above-named make salience under the skin, while between them are depressions; now—*i.e.*, when inflamed—the intervals are prominent, the locality of ligament, etc., marked by depressions; thus each articulation has, when thus inflamed, its own peculiarities of form. Moreover, and this point alone is almost sufficient for diagnosis, the tumefaction in the more superficial joints fluctuates very evidently.

The Shoulder.—The deltoid looks fuller and broader than the norm or than the other side.[1] This is best seen by seating the patient on a low seat and looking down on the shoulders from above; or if this, as will sometimes happen, be inconvenient, the surgeon may get the same view by standing on a chair, placed close to that on which his patient is seated. The humero-pectoral groove is at its upper part nearly obliterated, or rendered indistinct.

The depression at the back below the acromion is lost—the axilla appears to the finger shallower than usual. An inflammation of the subdeltoid bursa may be mistaken for synovitis of the shoulder, but this disease simply enlarges the outer parts, broadens the deltoid, without giving rise to the other signs just mentioned.

The Elbow.—Normally, there are depressions on both sides of the triceps tendon and olecranon process. Synovitis not only fills them up, but changes them to elevations. At the lower end of the outer groove the depression which marks the junction between humerus and radius, best felt with the finger, is also filled up or rendered indistinct. On a front view the joint looks unnaturally broad. When effusion is considerable it even somewhat so separates the bones, that the sigmoid notch does not lie close to the trochlea; therefore when the arm is at right angles, firm pressure on the olecranon will cause it to yield a little, as though the part were elastic. Fluctuation between different parts of the joint may easily be detected, from one side of the triceps to the other, from either of these to above the head of the radius, etc.

The Wrist.—Round the back of this joint there runs, in acute synovitis, a bracelet-like swelling, which is more marked laterally on either side of the extensors of the fingers, and between the extensor ossis metacarpi, and extensors primi and secundi internodii pollicis; in front also, at either side of the flexor tendons, it is perceptible. It cannot be mistaken for enlargement of tendinous sheaths, for these behind are very superficial, generally bi- or trifurcated and fusiform, the long axis being parallel with that of the arm, not, as in synovitis, at right angles with it; in front, enlargement of the large tendinous sheath produces swelling in the palm and wrist—a bis-aculeated swelling.

The Hip.—At this joint tumefaction is to be sought in the groin below Poupart's ligament, and also behind the great trochanter. In the former place a rounded swelling will be found about the middle, though rather below the groove dividing thigh from abdomen; it is more easily perceptible on looking along the surface of the extended limb from the knee upward than straight down upon the part. In the latter point the swelling, simply more or less, fills up the post-trochanteric fossa. If the patient, lying on the back, have the hams placed on a rather thin pillow so as slightly to flex the hip, and if the surgeon then place the thumb of each hand below the groins, the fingers in the post-trochanteric fossa, he will feel decided difference of dimension between the sound and diseased side. When

[1] Let not the acquired difference between the stronger right and weaker left side mislead the beginner, nor (a mistake I have known to be committed) a left-handed man be thought to have a swollen left arm.

the fluid is large in quantity, some swelling may also be felt in the angle between the thigh and perineum. With regard to this joint, it should be mentioned that the disease in question usually produces apparent lengthening of the limb, but sometimes apparent shortening.[1] Swelling, as a sign of disease at this articulation, is comparatively unimportant. Two bursæ about this joint may lead to erroneous diagnosis. The one situated under the gluteus maximus causes, when inflamed, some obliteration of the hollow behind the trochanter, but the swelling is diffused over a larger circumference than in hip disease, even to the outer surface of the trochanter major, while swelling and tenderness at the groin are absent. The other bursa lies beneath the psoas and iliacus as it passes over the head of the bone—it must, however, be remembered that this bursa often communicates with the synovial cavity; if it be a separate sac, and were to be acutely inflamed, the presence of swelling and of tenderness at the groin, the absence of any such symptoms behind the trochanter, and at the spot above mentioned near the adductor origins, will lead to correct diagnosis.

Knee.—Acute synovitis of the knee is very readily diagnosed. When the intra-articular fluid is pretty copious, it not only obliterates the usual depressions, but actually transforms them into elevations. Thus the hollows which naturally lie on each side of the rectus tendon of the patella and its ligament may be so protuberant that those tendons and bone lie almost in a groove; the popliteal space is more or less filled up. If the patient be made to stand with the knee not quite straight and muscles relaxed, the surgeon may place his finger on the patella, and pressing it with a quick motion backward will feel it knock against the femoral condyles, and he will see at the same time the parts around bulge forward, so that the hollow in which the bone now lies is considerably increased; this might be described as "seeing" fluctuation. In many cases, especially when the disease has lasted some time, the subcrureal cul-de-sac will be particularly prominent.[2]

Two bursæ are situated in front of the knee-joint, a large one between the patella and skin, a small one between the ligamentum patellæ and the tibia above the tuberosity; this latter sometimes communicates with the joint. It is scarcely conceivable how inflammation of either of these can be mistaken for synovitis of the knee. The former bursa, when inflamed, causes a very prominent swelling over the patella, rendering this region markedly protuberant, while in synovitis it becomes concealed and less prominent. Inflammation of the latter bursa produces but little swelling, which much resembles an enlargement of the tibial tuberosity, but it never rises high enough to be mistaken for knee-joint disease; moreover, the seat of swelling and of pain is much more limited.

Ankle.—The swelling is chiefly anterior, extending like an anklet round the limb; but is most prominent immediately in front of the malleoli, chiefly of the external; some swelling is generally perceptible behind those processes. It should be remembered—and this diagnostic mark is even more important in chronic disease—that the long axis of synovitis runs across the limb, while that of effusion into tendinous sheaths with the line of the limb.

Combined with this subject of intra-articular swelling, mention should be made of positions which M. Bonnet believed the limbs to assume, in

[1] This subject of apparent lengthening and shortening will be more fully described in the chapter on Hip Disease.

[2] See chapter on Chronic Hydarthrosis.

order to procure for the synovial membrane the greatest capacity. I have not, however, found that acutely inflamed limbs assume these postures with such regularity as to induce me to quote M. Bonnet's experiments here.[1] In more chronic forms of inflammation and of suppuration in joints peculiarities of posture are more important.

The constitutional symptoms accompanying acute synovitis of the serous variety are generally very trifling. During the first few hours, especially if pain be present, some slight pyrexia, some slight rise of temperature, may be noted, but this, if the malady remain simple, very soon subsides. Somewhat more marked disturbances accompany those more severe forms, as after grave injury, when, as we have found (p. 26), blood is often poured into the joint-cavity; as also the cases when the cell-action is rapid, considerable opalescence of the effused fluid is probable. Indeed severe synovitis should be carefully watched, not only locally but generally. Any rise of temperature, excitement of pulse, heat and dryness of skin, should cause anxiety; and if such change have been ushered in by a rigor, the dread of approaching danger is changed to the certainty of evil already present.

Symptoms of Dry Synovitis.—Dry or fibrinous synovitis, whose pathological significance I described in a few words, is clinically of great interest. It is easily distinguished from the simple or serous variety by the fact that heat and usually also redness are present, in these symptoms coinciding with the serous malady, while the pain of dry synovitis is far more severe, and in the fourth symptom, namely, swelling, the difference is marked both in amount, form, and persistence.

The only joint which I have ever seen attacked with *Synovitis sicca* has been the knee, probably once or twice the hip; nor have I found recorded a case which I could ascribe to this disease in any other joint. Its most prominent symptom is pain, which, although various in different cases, both in amount and character, is always severe to a degree which bears no comparison with the pain of serous synovitis. The surgeon unacquainted with this particular form of disease will probably search again and again for pus. In the less violent forms the pain is paroxysmal and remittent, occasionally even periodic. I shall shortly quote a case in which the pain recurred with almost precise regularity every seven hours, so that the seventh day it exactly resembled the first. In the most severe forms—and these are terrible cases to encounter—pains of the most unbearable acuity rage night and day for weeks, although nearly always with some period of abatement rather than of intermission.

Pyrexia is always present, but it bears no proportion to the painful symptoms; that is to say, a suppuration producing such suffering would be accompanied by a temperature of 102°—3° or even more; but dry synovitis rarely raises the thermometer above 100°, and this only while the pain lasts. The skin feels hot and dry in the daytime, though severe sweating may occur at night; the sweat under those circumstances smells sour.

The appearance of the joint is very peculiar, and I fear indescribable. It is very little swollen, and the slight enlargement seems rather to increase and broaden out the natural prominences, while the depressions, especially that on each side the ligamentum patellæ, are filled up: the skin, of a dull

[1] In the first edition of this work M. Bonnet's forcible injections into joints and their results were given at considerable length; subsequent experience has caused me to attach very little value to them.

red hue and of leathery aspect, looks lightly stretched over these underlying parts, and is somewhat shiny; when the disease has lasted a little time, there is what I may term a superficial or shallow œdema, almost as though the skin itself, but nothing deeper, were infiltrated. The joint has a very helpless, good-for-nothing look, and this appearance is increased by extremely rapid wasting of the thigh-muscles, more rapid even than after fracture of the patella, much more so than during sero-synovitis. The pain is apparently so intense that it is extraordinary how any being can endure it for the length of time that it sometimes lasts, but the disease occurs only in unbroken constitutions; the sort of inflammation, unlike the suppurative, makes no large call on the system, and the pyrexia is not sufficiently high to be of itself an injury. Therefore when a painless interval occurs the patient sleeps well, and takes food with ease, often indeed largely. He thus, as it were, gains strength for the next attack.

These cases are fortunately rare, nor can I with precision denote their etiology. The usual termination is anchylosis; yet sometimes the patient will get well with a knee somewhat stiffened, chiefly by muscular contracture, only to a degree which passive motion and rubbing, followed by active movements, will remove (see Case VII.); more rarely still suppuration may after a long time appear.

Treatment.—Acute Synovitis (serous) rarely requires any constitutional treatment whatever. At the outset, if the patient be constipated, a brisk purge, containing, unless circumstances forbid, some mercury, is desirable. I have believed that in many patients advantage has followed the addition of some Colchicum wine to the draught following a pill containing mercury, more especially if the attack be immediately attributable to some exposure to cold. Again, if the urine be highly acid, especially if it deposit lithic acid, treatment adapted to that condition will be desirable.

More than this is, as a rule, unnecessary, therefore to be deprecated; but every now and then a case will occur of such strongly marked inflammatory character, accompanied by such considerable pyrexia, that medicinal treatment is demanded.

Mercury in repeated doses used to be, and is still by some of the profession, employed; although its advantages in acute inflammations, especially on those tending to fluid effusion, is more than doubtful, and has decided drawbacks in case the disease assume another phase. I prefer subduing the fever by rather large doses of citrate of ammonia in an effervescent form, especially if the urine be very acid, or by small doses of antimony combined with the above draught; or, should pain be pretty severe, with opium. I have also used digitalis and atropia (see Formulæ V. and VI.) with good effect.

Mention has been made of opium and of other calmants. I estimate their value in accordance with the symptom-pain. I am sure that in many acute inflammations, particularly of joints, pain very frequently acts as a direct irritant, and ought to be subdued, especially after injury, to which cause a large proportion of the severer cases of synovitis are due.

In the local treatment, the first great essential is rest, in a good position; not merely putting the limb on a pillow and enjoining stillness in any posture that may at the moment be most comfortable to the patient, but absolute and enforced immobility in that position which experience has proved to be most conducive to cure. We have seen that when a joint is attacked by inflammation the limb-segment below becomes more or less fixed in a certain grade of flexure, and that if the disease continue, more especially if it become more severe, this degree increases, and often attains an exces-

sive amount. Such condition, which I shall call malposture,[1] is, although immobility be secured, very antagonistic to recovery; and even if the inflammation be subdued, the limb will be left in an awkward posture, for after treatment, the restoration of perfect flexibility will therefore be unnecessarily prolonged and painful. The proper position for the shoulder is medium; that is, the arm should hang by, but a little away from, the side, the hand lying upon the lower part of the chest. The elbow should be bent at a right angle with the hand midway between pronation and supination; that is, with the thumb upward. For the wrist, a perfectly straight posture, the hand in a right line with the forearm, thumb upward, is very essential. The hip, when acutely inflamed, should be kept extended; in some cases very slight flexure may be permitted, but the greatest care should be taken to avoid adduction; abduction is less deleterious, but nevertheless it is better to obviate that posture also. The knee should be slightly, and only slightly, bent. A perfectly straight position is very apt, during acute synovitis, to induce that form of irregular muscular contraction called "cramp;" rotation outward of the tibia must be watched for and guarded against. The foot must in all inflammations of the ankle-joint be kept at a right angle to the leg. Certain authors recommend an angle slightly obtuse; this, for many reasons, is, I am sure, a mistake.

It rarely, yet sometimes, happens that, in acute simple synovitis any malposture is assumed so strongly that it cannot be redressed; *i.e.*, placed in one of the above positions with ease. If, however, there be any difficulty in doing this, or if the attempt cause considerable pain, an anæsthetic is to be administered, and the limb put into the proper posture.[2] Under the influence of narcosis there is no resistance to restoration of posture; the fixity at this period arises, not from passive contracture, but from active contraction of muscle, which is eliminated by narcosis; there is as yet no resistance from the tissues of the joint itself, hence no force is required to put the limb into a proper position, but the surgeon should not, except simply to effect his object, move the joint at all. Before administering ether, the appliances for fixing the limb should be in readiness. For the shoulder, are required merely one or two bandages, and a wedge-shaped pad or cushion (Esmarch's acts very well), to keep the arm a little from the side. For the elbow, I prefer a rectangular splint; if it be of wood or metal it should be made of two gutters, one for the arm, one for the forearm, fastened in their places by a bar of steel or brass, running across the angle. More convenient, however, and in most cases more efficacious, is a splint of poroplastic felt, leather, or pasteboard moulded on the limb and sufficiently broad to enclose half its circumference. For the wrist, an arm-splint with hand-portion. The hip often requires careful management, and the choice of means will depend in great measure upon the size and idiosyncrasy of the patient. The reader is referred to the special chapter on Hip Disease, for various means of fixing that joint. I will only say here that some extension is desirable, the best means of applying it is either by

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[1] This term is not intended to denote that the joint is in a position which it cannot normally assume; indeed, it is rare that an acute joint-disease produces an amount of flexure equal to that which is frequent in the usual movements of the body. The term has rather reference to the fixity of the posture and to its deviation from that which we know to be most sanatory. I must here forestall what belongs to a future subject, that in certain joints these malpostures conduce to subluxation.

[2] This procedure is more frequently required in other maladies, and will be referred to again; the hip must be excepted when speaking of the rarity or the easy rectification of malposture (see Chapter XIV.).

my extension-splint, or by the Desault on the sound, and weight with pulley on the diseased limb. For the knee, an Amesbury splint, fixed by the underscrew in slight flexion, and with the foot-piece not quite at right angles, is the best. It gives ease and comfort to some patients who are restless in bed, to swing the splint and limb in a Salter's cradle. For the ankle, the same splint may be used, or a moulded splint to either the outer or inner side ; it must, however, reach from half-way up the leg to the ball of the great or little toe, according to the side chosen.

Some surgeons, more especially in Germany, reject splints altogether as means of giving rest to inflamed joints, and insist upon immovable bandages, either of plaster, chalk, or gum. These appliances are in some forms of disease essentials ; but I have found well-fitting splints quite sufficient for the treatment of simple acute synovitis, and they have certain advantages—the surgeon can see the joint and watch its progress, it lies open for any desirable application. A drawback to the immovable bandage is, that the tumefaction, at first present, will, if the case proceed favorably, subside, the appliance then get loose over the joint, but still exercise pressure above, favoring blood-stasis in and around the synovial membrane.

Having placed the limb in the proper position upon its appropriate splint, we proceed to the consideration of local treatment. A slight synovitis, which exhibits but little tension, will get well with rest merely, or if of a rather higher degree with the aid of certain remedies to be considered hereafter ; but if the inflammation be sufficient to cause considerable secretion into the joint, producing marked fulness of its sac, the synovial membrane should be punctured, in a few cases incised (subcutaneously), to relieve the tension. In my first edition I spoke of this treatment with commendation, although I had not at that time used it ; very shortly after publication of the treatise many opportunities for putting my views into practice arose, and I have employed the treatment ever since with the greatest advantage.

The aspirator of Dieulafoy, though it occasionally disappoints, is the instrument most easily employed. The surgeon selects that portion of the joint where the distended synovial membrane is most widely separated from subjacent hard parts ; here he passes the tubular needle into the cavity and applies the vacuum. It is desirable to wash the steel with carbolic acid, and to dip it just before use into carbolized oil ; it is prudent also not to choose the smallest-sized tube, lest any flocculi should block it—a most disappointing event. If the whole apparatus be not at hand, one may effect the same object in a manner perfectly free from danger, either with the tubular needle alone, or better with the addition of an india-rubber tube two or three feet in length, and of one-eighth inch lumen. Indeed, where I have some reason to suspect the presence of fibrin flakes, I often proceed in the manner about to be described, because it seems to me that the strong vacuum suction draws such flocculi a little way into the needle, but fails to suck them through it, whereas without such power they merely impinge against the end and fall, or may be shaken off. The little operation without the vacuum is thus performed : an elastic bandage is placed with some tightness on the joint, omitting between two turns the spot to be punctured. Into this I have occasionally passed an unguarded needle, and believe that the pressure of the band entirely obviates any danger from ingress of air. It is well, however, always to be very cautious ; therefore I fix a small tube to the collar of the needle, and fill it with a three per cent. solution of carbolic acid ; while an assistant or nurse holds the end of the tube a foot or so above the level of the joint, the needle is passed into its cavity, and the

tube is at once lowered, till it hang perpendicularly, or nearly so, downward; with the exception of the last two or three inches, this should still incline upward, avoiding, however, any sharp bend. Fluid immediately begins to flow, that in the curl of the tube acts as a trap to the ingress of air, and, the capacity of the tube being already known, we can ascertain the amount of secretion withdrawn. It averages in the knee four ounces, but may, even in a recent case and first attack, amount to six or seven. From the shoulder three ounces is a large quantity; the capacity of an inflamed elbow is rather less.

If from the presence of many flocculi, or sometimes from viscid quality of the fluid, it be found impossible to empty the sac through the aspirator needle, it is better, rather than risk admission of air by endeavors to clear the tube, to pass a tenotome obliquely through the same skin-puncture, and make in the synovial membrane an opening sufficiently wide to allow the liquid to drain into the peri-articular tissues. However it may be effected, this emptying of the synovial membrane is very important whenever the secretion is sufficient to cause tension.

This treatment, far from being severe, is the kindliest remedy, and always procures instantaneous or almost instantaneous ease. Moreover—and this is indeed the most important point—it nearly always subdues, almost at once, the inflammation. It seems to me, that those who have never employed this remedy, are not likely to estimate it at its full value; nevertheless certain clinical analogies will show its mode of action. Thus, a severe sprain or contusion of a joint will not unfrequently produce severe synovitis, with great distention of the synovial membrane, pain, etc. A dislocation is very rarely indeed followed by any demonstrable synovial inflammation. The latter injury is more severe than the former, but it is accompanied by laceration of the joint-bag, which, permitting the escape of fluid, prevents distention. Again, a fracture into the joint will doubtless set up such irritation as produces hypersecretion, but the result drains away, and no marked synovitis follows. Here we must except some cases of fracture of the patella, which, and their varieties, furnish a crucial proof of my position. When, in such cases, the breach of continuity does not extend through the fibrous covering of the bone, a smart synovitis usually follows; when it does involve also this fibrous tissue, the fluid, excessive in amount, infiltrates the neighboring areolar tissue, and synovitis, *i.e.*, anything beyond the mere irritation, which produces excessive secretion, does not follow.

Hence it is evident that the occasional obstinacy of, and the difficulty of curing, a synovitis depends in great measure or entirely on *tension*, and that if we relieve this condition by evacuating the fluid, we shall have overcome the chief obstacle to recovery.

Cold.—After evacuation of the joint, pressure should be applied, either with an elastic or other bandage, or now, if it be preferred, plaster-of-Paris may be employed; but it must be recollected, that if the case be severe, a repetition of puncture may be necessary, or other means may be advisable, which can better be employed if the surface be accessible. Among the most powerful antiphlogistic remedies, especially if the joint be superficial, is cold. This application has, like warmth, been very differently estimated by different writers, the cause of the divergence being the various methods of application: a wet rag, changed whenever it may seem good to the attendant, is sometimes warm, sometimes cool, as also is a compress wrung out of hot water; but real cold applied on a fairly superficial joint has always the effect of reducing hyperæmia. The best method

of application is to place a number of small pieces of ice in one of the large-mouthed india-rubber bags kept by all instrument makers, and so to suspend it upon the wires of an ordinary bed-cradle, that while in contact with the surface of, it yet may not press upon the joint. Of course watch must be kept that as soon as the ice is dissolved it may be renewed ; the smaller the lumps the sharper the cold, and the more frequent must be the renewal. In some patients, chiefly in those of rheumatic tendency, cold produces absolute pain, and in such persons the immediate discomfort is not the whole, nor indeed the chief, evil, a state of chronic painful inflammation, not, I believe, of the joint itself, but of the subsynovial peri-articular and tendinous tissues, that which people call a rheumatic joint, is often left behind. Therefore I do not apply cold to those in whom I can find evidence of rheumatism, to those above forty, unless in fine health, nor to those who are asthenic and lax of fibre.

Heat.—To blow hot and cold is a proverbial reproach, yet there are many cases in which we may use either remedy, and certainly a goodly number when the choice between the two is doubtful. Cold acts by absolute constringing the vessels ; for the first few seconds it may be presumed that (blood being driven from the surface toward the deeper structures) the application increases the hyperæmia of the synovial membrane ; but after the lapse of those moments the effect penetrates deeper and deeper, so that at last the vessels of the joint itself are contracted on their contents, and not only does the hyperæmia cease, but even a local anæmia is produced. This, probably, could not be effected in so deep a joint as the hip, but in all other large joints such results follow the application very rapidly. Heat, probably, acts as a derivative, for, since under its application more blood flows to the superficies, less must pass, at least for a time, to the deeper structures having the same vascular supply. In anæmic, rheumatic, gouty, and elderly persons, heat is a safer remedy than cold—but it should be really heat, not merely warmth. The most agreeable way to apply it, and that producing least weight, is by means of flannel bags filled with hot salt, which, like the ice-bags, are to be suspended from the cradle. There should be two bags, and while one is in use, the required quantity of salt should be heated in an oven or on an iron plate over a gas-stove, or in some other convenient way, to fill the second when the first bag has got cool, and thus heat should be kept up for several hours.

Local Abstraction of Blood is valuable in severe synovitis. Notwithstanding the almost contemptuous rejection of this treatment by some authorities, I must, from experience, maintain its value. Nevertheless its use should be restricted to severe cases in their early stage, when inflammation and swelling are on the increase, when the joint is hot, and when pyrexia, even though slight, be undoubted. Its value is more especially marked in the synovitis following injury, especially if rapid swelling immediately follow the accident, and the case be seen early, previous to stasis, which begins on the venous side of the circulation. In dealing with the more superficial joints, as the knee and elbow, it is better not to apply leeches immediately over them, but rather above them, in the course of the larger superficial veins—the internal saphenous for the knee, the basilic, or that and the cephalic, for the elbow. A caution as to the repetition of bloodletting should be given, for there comes a time when it will do harm, namely, when there is no general pyrexia and no local heat ; when, indeed, the continuance of the swelling appears to depend as much on a want of contractility, a topical asthenia of the vessels, as on any active condition.

Blisters, or other Counter-irritants, are useless, and at times even hurtful

in this stage of serous synovitis. Later on in the malady, and, as we shall shortly see, in other forms of synovitis, such treatment, properly directed, is very valuable. But while there is acuity of inflammation, hyperæmia, and heat, all such remedies are to be postponed until these immediate symptoms have ceased, and until our efforts are to be directed, not so much to prevent secretion as to promote absorption.

Many pages more might be written concerning sundry remedies, or supposed remedies; but, in truth, acutely inflamed joints, treated in the manner and by the means above indicated, get well, or run on, and this is a rarity, to suppuration, which belongs to our next chapter. The patient, however, may have either inherited or acquired a diathesis, which, when the inflammation subsides (acute surgical inflammations are not diathetic), mingles with, and impresses its form and mode of action on the original disease. Thus we may have an accidental or traumatic origin of a gouty, rheumatic or fungoid synovitis, and these conditions fall in this work under their special headings. But in a person gifted with none of these peculiarities of constitution the simple serous synovitis will nevertheless leave behind certain sequelæ, whose final disappearance may be very much expedited by well-directed treatment.

We have seen in our previous section that a peculiar laxity of the synovial membrane, ligamentous thickening and other troublesome conditions, are apt to be left behind by a synovitis, which causes considerable distention of the joint-sac,[1] and these difficulties are generally increased by stiffness of muscles, etc., as already described. All these, but more especially the extra-articular inconveniences, are increased if entire quietude be enforced beyond the time when, inflammation having disappeared, such rigidity of treatment is needed. The symptoms already described will lead the surgeon to know when the time has come for changing his strategy. If, then, active inflammatory mischief have been subdued, the joint must be examined to determine the state in which it has been left. Distention of the synovial membrane and surrounding parts, together with passive, *i.e.*, non-inflammatory accumulation of fluid evidently dictate certain aims, viz., to promote absorption and contraction, while absence of laxity or fluid accumulation, but considerable crackling, lead our endeavors in a different direction.

In the former of these conditions any form of counter-irritant or vesicatory is, to a certain extent, useful. An ordinary blister, applied in a superficial joint not immediately over the synovial membrane, but a little higher on the limb. The liquor vesicatorius, iodide of potassium ointment, or the strong tincture of iodine (Formula, Iodine), may, any one of them, be employed; but in using such applications it must be remembered that any considerable vesication will, for a long time, prevent the use of some of our most useful remedies—pressure and rubbing. While, therefore, we may judiciously employ cantharides or similar counter-irritants, their action should stop just short of vesication, and the application be repeated on another part of the skin in the immediate neighborhood.

If under those circumstances pressure be at the same time desired, this can be accomplished by covering the irritated surface with a smooth layer of cotton-wool and applying an elastic bandage, either the solid india-rubber or, which I prefer, elastic webbing, in the use of which care must be taken not to strain the material too tight, lest obstruction of circulation be pro-

[1] Evacuation of the fluid by puncture or incision obviates these results, if it be practised early enough, almost entirely.

duced. If the patient be in a fit state to use a little the diseased limb, it may be desirable to add to pressure a little support, as with a strong strapping-plaster—for instance, the Ung. Resinæ spread upon a stout twilled calico, cut in strips, and covering the joint smoothly and firmly. Some practitioners think highly of certain medicated plasters, as the ammoniacum and mercury, the warm and the iodide of lead plaster. While believing that the chief use in strapping a joint is mechanical, I cannot deny a probable action in some of these plasters,[1] and do not object to them if only they adhere firmly enough.

The stiffness is best overcome by rubbing, combined first with passive and then with active motion. If the joint-attack have been unusually severe and protracted, more especially if of traumatic origin, such immobility may be left, that restoration by gradual motion will be a very slow and even painful process; in such cases much time and discomfort are saved by straightening, and otherwise moving the limb during ethernarcosis. A full description of the method is given under the heading false anchylosis. Nothing need here be added, save that repetition of the manœuvres is very rarely required, but that passive motion on the next and following days should be kept up. The elbow and the knee are the joints which most usually suffer from protracted difficulty in recovering free motion; for both I am in the habit of ordering forms of passive or semi-passive movement, which I find very valuable; that for the knee, as being the more simple, I will describe first. A good many years ago it suggested itself to me that I might relieve the uncomfortable grating, of which a patient, using passive motion, complained, by causing him to do this under extension, and I have since used that device. Let the patient sit on a table—one without drawers or any obstruction under the flat—taking care so to place himself that all the back of the thigh is supported, the edge of the table coming close to the hamstrings. Let him swing the leg backward and forward in measured rhythm, having a one, two, or three pound weight attached under the sole of the foot by a handkerchief, napkin, or bandage, tied sandal-wise. The larger weights are of course adapted to stronger persons, but are more especially indicated if grating be coarse and harsh. One convenient way of fastening the weight, giving every facility for variation, is to make a long bag, about as big round as the wrist, in the centre of which the desirable quantity of shot is placed, and the rest is used to tie round foot and ankle. If we chiefly require to obtain mobility in the direction of extension, the patient, instead of sitting, may lie prone on the sofa, his knee just on the end protected by a soft cushion, a slight weight, from one to two pounds, fastened on the foot, and let the leg be swung up and down. The same intention can be carried out at the elbow if the patient sit sideways on a chair and hang the arm, rotated inward, over the back (which must have no cross or centre rail). A weight must be attached to the wrist, and of course the upper arm must be guarded by a cushion; if extension be more particularly wanted, the back of the humerus, just above the elbow, may be rested on the table, and the arm swinging will give the weight all desirable force. Rubbing, pressure, and shampooing, sometimes the douche, more often hot bathing and wet compresses will, in the absence of diathesis, clear away the stiffness of a simple synovitis; but the means, if obstruction be considerable, must be carefully and perseveringly used.

Shampooing also has great effect, when properly used, in promoting the

[1] I must strongly warn practitioners against using the last-named drug on persons of gouty habit, or even of that hereditary taint.

absorption of any hypersecretion still remaining in the joint. Dr. Witt and Dr. Mosengeil have described various methods of "massage," as also their physiological effects.[1] Perhaps we need hardly subscribe in full to their distinctions, nor entirely credit different forms of rubbing with such very distinctive results; but yet may fully believe that pressure and friction, in an upward direction, will stimulate lymphatic and venous absorption, even press some fluid into the lymphatic rootlets.

In synovitis sicca, the treatment must follow somewhat different lines. In the first place the severe pain necessitates anodynes, either hypodermically or by the mouth. Sudorifics or diuretics, generally with ammonia, are useful. Aconite, I have thought, has had decided good effects. After a time quinine is of decided benefit. Locally warm moisture is better than cold, which, though it may alleviate for a time, brings on recurrence of the pain and seems to prolong the disease. Belladonna and glycerine, in equal parts, spread on strips of lint and laid smoothly on the joint, certainly after a time relieve. The oleate of mercury with atropia is decidedly useful. After the most acute phase has passed, blisters in the neighborhood of the joint, even going on to vesication, may be employed, and when the surface has quite healed, an application composed of iodide of potassium, and iodide of lead ointments, either in equal parts or a little varied from this, may be applied on lint for four to six days, often with the result of diminishing the hard swelling. One of my patients gained ease and advantage by a local use of the lamp-bath, which, by means of an india-rubber sheet, can be arranged without much difficulty.

Case III.—George M——, aged 27, laborer, admitted into Charing Cross Hospital, under my care, April 21, 1876. Having three days previously fallen from a cart and hurt the right knee; he thought little of the matter, but went on with his work. The knee became more and more painful and swollen; he could not sleep, and came to hospital in a cab.

The house-surgeon put the knee on a MacIntyre splint, keeping the patient in bed. When I saw him in the middle of the day, the joint was greatly swollen, the subcrureal bursa felt like a large elastic pad over the front of the thigh. The man complained of great pain; his pulse was full and hard, temperature 100.4°. I passed an aspirator needle into the synovial sac above and to the inner side of the patella, and drew away four and a half ounces of synovia, perhaps a little thinner than the normal. The joint was then rather tightly bandaged, and the limb replaced on the splint. That same night he slept perfectly well without opium.

April 24th.—The joint was nearly the natural size, and was not painful—temperature normal since the operation. I ordered that on the 26th the limb should be taken from the splint, the joint moved, and then strapped with strong calico, spread with resin plaster, and after three days passive movement used.

April 28th.—The man is anxious to go out, but he is told to remain another week.

Case IV.—Mr. L. F., aged 34, fell with his horse at a fence, the horse upon his left leg; he got home with difficulty, and when I saw him six hours after, March 4, 1879, he was suffering considerable pain both in hip and knee, but chiefly in the knee, which was swollen, but not very markedly. The limb was placed on a MacIntyre splint, and a large ice-bag laid

[1] Langenbeck's Archiv, vol. xviii., p. 275, and vol. xix., p. 429.

upon it. A sufficient purge, chiefly of podophyllin, was given, and a draught of half a grain of acetate of morphia at night if he was restless.

March 5th.—In spite of the draught he had a good deal of pain. The knee this morning was swollen, and very tense—a mark of a bruise on the inner side extending up the thigh. I put round the knee and splint an elastic web bandage, leaving a gap on the outer side, through which I passed a tubular needle, provided with india-rubber drain, and drew off forty-three drachms of fluid, looking like half-arterialized blood; but it was treacly, and with the peculiar lubricant feel of synovia. Floating on this fluid were several flocculi of much the same color, although when viewed against the white background of the bowl they seemed much darker. Soon after the joint-sac was thus emptied, the patient felt much easier, the elastic bandage, being now too loose, was reapplied. Over this the ice-bag was still used.

The fluid, left to stand, deposited red blood-corpuscles and leucocytes; also a few fibrinous clots.

March 6th.—The patient slept a good deal in the morning; nevertheless he passed a good night, the knee being very little painful, but filling again.

March 10th.—One spot on the inner side of the knee; three fingers breadth above the patella, there is a very painful and tender spot. Whether the synovial membrane was here directly bruised, or if some other cause for this tenderness exist, it is impossible to ascertain. With the hopes of preventing the joint filling again, the blistering fluid has been used, but only to strongly redden, not to vesicate; nevertheless fresh secretion took place, and there was some little tension. The patient was very anxious to have the joint tapped again, which was therefore done. The fluid was now only tinged with red, but it seemed thick, *i.e.*, inspissated, and had an opalescent look. This, left to stand, deposited abundance of leucocytes; some glomeruli, formed entirely of those bodies, conjoined apparently in a homogeneous jelly; also a few fibrinous concreta.

The puncture wound was covered with collodion, the limb enveloped in a flannel band, and then in plaster-of-Paris.

March 24th.—The patient has been comfortable; to-day the plaster was removed; the knee had nearly regained its natural size: the tender spot above mentioned still gave pain on pressure, but not by any means as much as it did. Passive movement and rubbing, then more movement and swinging the leg, were ordered, and a leather splint made, to be worn at night.

April 1st.—The joint may be said to be well; the patient walked a little without difficulty, but could not go far. The muscles of the thigh were weak; yet a few days more exercise will cure.

Case V.—James MacS. was admitted, under my care, into Charing Cross Hospital, January 6, 1880, with greatly swollen and very painful knee. He had an old gonorrhœa; he had had no shivering, no polyarticular affection. I did not look upon it as a gonorrhœal synovitis, for which he was sent in, but as simple synovitis in a man who had gonorrhœa. The swelling, too, was entirely intra-articular, the patella knocked plainly, the subcrureal sac felt as big and almost as hard as a cricket-ball. The joint was tapped—the fluid looked like pus, *i.e.*, was laden with leucocytes. The man required no fresh tapping, merely ice and splintage, and was discharged, cured, on the 1st of February. I do not consider that there was any connection between this purulent condition of the joint-fluid and the existence of a gonorrhœa. The local condition—viz., an enlargement entirely intra-articular, the general condition, absence of rigors, a temperature not above 100° Fahrenheit, and mon-articular joint-affection, forbade this idea.

Case VI.—In May, 1876, I was requested by Mr. Bannister, of Oxford Street, to see with him a lad, aged 16, who four days previously had fallen just as he was starting for a long walk. On returning, his right hip was painful, and he could only get along very slowly; he arrived home very cold and in great pain. Next morning he could not get up, and for the next few days his troubles greatly increased. When I saw him, with Mr. Bannister, he was lying on the left side, his right thigh was thrown over its fellow, and rested on the inner condyle on the bed; it was very much bent on the abdomen and adducted, the slightest attempt to move it caused him to cry out fearfully. Chloroform was given, and under its influence he was turned on the back; the weight of the limb then caused it to fall of itself nearly straight; a very little additional traction with the hands placed it in perfectly good position. A weight of three pounds was then suspended on the limb, which was further immobilized by an arrangement of an additional sheet. Examination of the hip when thus straightened showed there to be considerable effusion in the joint, which manifested itself both at the lower groin and behind the trochanter. Mr. Bannister undertook to watch this, and to let me know if it increased. In two or three days I received a message from that gentleman, saying that the tumefaction had nearly disappeared. In four days more some flying blisters, alternately on the two spots above named, dissipated the last remains of tumefaction.

The pain, which, while the limb was in malposture, had been intense, almost disappeared after restoration of a good position. Some morphia had been given on the first two evenings, but after that, was discontinued as unnecessary. In three weeks the young fellow was walking about with ease.

Case VII.—Mr. H., in getting into a railway-carriage while in motion, was struck on the inner side of the knee, and thrown backward on the platform. He felt no pain or uneasiness, save a little stiffness, for fifty hours after the accident, when a sudden stab of pain occurred. Four days after the fall, viz., on May 15, 1872, he sent for me. I found him in great pain, but during the night, his wife told me, he had been in absolute agony. The pulse was 98; the thermometer marked 102.2°. The tongue was clean; but white, and indented at the edge by the teeth. In the middle of the thigh in front, and extending to the inner side, was a bruise. The knee was, as verified by comparative measurement, very little swollen—it did not fluctuate nor pit; it was rather hard and leathery in feel—the skin seemed somewhat immovable over it. The most conspicuous change was that of shape—the usual markings of points of bone or tendon being merged in the peculiar square look of the limb—a squareness which singularly contrasted with the rounded shapelessness of certain synovial maladies, and the definite form of sero-synovitis, while its resiliency and want of fluctuation also were remarkable. The knee was evidently hotter than the other; manipulation produced but slight discomfort. Pain came on in paroxysms, irregularly, and chiefly at night. The joint was a good deal flexed, and the thigh nearly an inch less in circumference than the other placed in the same position.

For nineteen days and nights these paroxysms of intense pain continued. I saw him in two of them, and they seemed most severe. He was treated by placing (during narcosis) the limb in a good position on an Amesbury splint, slung in a Salter's cradle; hot application of bicarbonate of potash, under thin mackintosh; belladonna and glycerine; by hypodermic injection of morphia; effervescent ammonia; effervescent ammonia with wine of colchicum; occasionally by drop doses of aconite—also by quinine. At the end of three weeks by blisters above the joint; afterward blue ointment was applied to the knee.

On the twentieth day after I first saw him decided remission commenced, and in five days more almost entire freedom from pain set in. A fortnight after I found that the joint enjoyed a small range of perfectly free and painless movement—at either end of this arc a sharp check was experienced. Passive movement effected little improvement, but produced no return of inflammation, though persevered in for ten weeks. Under ether the knee was flexed with little force, when, with a sharp snap, some morbid band was broken, and full movement was at once restored. This freedom was less when he became conscious, but sedulous exercises quite restored full mobility in about three weeks.

CHAPTER III.

SUPPURATIVE SYNOVITIS.

The description in the preceding chapters of pathological changes occurring during serous synovitis, includes an account of how the previously clear synovia may become opalescent and milky from admixture of cells; it was shown not only that the difference between such fluid and pus is one merely of degree, but also that even this degree is often overstepped, and the fluid in the joint becomes, both chemically and physically, pus, but a pus secreted merely by the surface. Such change, when gradual, by no means brings with it or is accompanied by marked increase in the urgency of the symptoms; indeed it may and does often arise when the first violence of the malady has somewhat abated, the separation of a redundant cell-brood from the free surface being, under such circumstances, the climacteric term of acute inflammation, the casting away of a morbid production. It may happen—indeed it was at one time thought to be a common event—that an acute serous synovitis may, whether or no it pass through the phase just figured, suddenly put on a graver aspect and run into suppuration of the joint. In point of fact, however, this is not the usual course of events; an inflammation of the synovial membrane which is to become suppurative, betrays at once its character, and, even before pus can have had time to form, shows, by the local and general symptoms, that a more serious malady than a mere simple synovitis has been set up. Moreover, a large proportion of joint-abscesses follow injury, especially penetrating wounds of the articulation, markedly if such wound be made with a foul instrument, or under circumstances which have necessitated long exposure to the air. It is a mistake, however, to suppose, as was, I believe, generally supposed prior to the first edition of this work, that wounds of joints are of necessity followed by suppuration of the cavity. I reported then several cases, and have seen many since, in which the accident was followed by no such ill-effects; nevertheless the surgeon must always watch joint-wounds with care, even with anxiety.

When a suppuration of the joint (not merely a purulent secretion from its inner surface) has commenced, the histological changes are in all respects the same, whether it have or have not been preceded by a period of less severe inflammation, or whether it have at once followed a wound. So rarely, however, do opportunities of examining human articulations in the earlier phases of suppurative synovitis occur, that animals have frequently been made the subject of experiment, in order to demonstrate the first steps of the process. Among these M. Richet's observations may be quoted:

"Having opened a joint in several dogs, and sometimes several joints of the same dog, I was enabled to establish the following facts; but not without difficulty, owing to the extreme agitation of the animals, and to the small extent of their synovial membranes.

"The membrane, either exposed or touched with some irritating liquid,

could be seen after the lapse of from four to six hours to become reddened, the redness appearing to belong more particularly to the subserous tissue.

"After ten hours the membrane lost its polish, but I never at any time could find that it was drier than in the normal condition. This dryness of the serous membranes in the first stage of their inflammation is admitted by all authors, and yet nothing is further from proof. This peculiar state, which has never been shown by direct observation to exist, has been invented to explain their crackling (*bruit parcheminé*). May this not be explained by the loss of polish, itself determined by the falling away of its epithelial layer; or, to speak more clearly, may it not be caused by the loss of their habitual flexible condition? On the next day the redness appeared more superficial, and more particularly as though distributed in patches resembling spots of ecchymosis. The serous surface was dull, and covered by a sero-sanguinolent layer, which soon became more abundant. After forty-eight hours the synovia became thicker, and assumed the color of wine-lees; the synovial membrane beneath this began to get granular.

"On the third day, real but badly formed pus flowed from the wound; the synovial membrane at this time was nearly uniformly red. There was much sanguineous congestion in the neighboring tissues, and when the synovial surface had been well wiped with a piece of linen, there were seen, on looking against the light, fine granulations, which I would compare to those observed on the inner surface of the eyelids in old blepharitis, but they were more marked. During the following days all these appearances increased, and from the fifth to the twelfth day was observed upon the surface of the synovial membrane a pseudo-membranous exudation, which seemed to me to form intimate adhesions with the granulations above described. At a latter period the synovial membrane could be seen to swell, to form a fringe, a true chemosis, round the cartilages, which, in the midst of all this disorder, preserve their normal whiteness.

"In one case, when I killed the animal sixty-three days after having injected pure alcohol into his synovial membrane, causing thereby a freely suppurating inflammation, with neighboring abscesses, I found these synovial fringes encroaching so greatly upon the cartilaginous surfaces as almost to conceal them; nevertheless they could be displaced by the end of the finger; and then it was perceived that they not only had contracted no adhesions to the cartilage, but also that these latter had suffered no change, except a slight loss of brilliancy, and that they were thinner than natural."

It appears to me not only an interesting but an important study to trace these actions and to examine their source and character. Acute suppuration, wherever it may occur, is distinguished from other forms of inflammation by an enormous production of cells, not only in the pus itself, therefore elaborated from the surface, but also in the tissues. For a considerable distance from the pus-producing focus, every cell-space and every cranny appear, under the microscope, crowded and crammed with cell-forms. These innumerable cells, and the masses of granular protoplasm which in the tissues surround them, must, according to those who would explain all inflammatory products by means of Cohnheim's migrated cells, originate and be the descendants of white blood-corpuscles; while the earlier cellular pathology of Virchow would ascribe to them a different parentage, viz., the tissue-cells which have largely and freely proliferated. Though far from denying that in synovitis, and especially in its suppurative form, a number of white blood-corpuscles do migrate from the vessels into the tissues, and do there gather around themselves a liquor, I confess that I cannot ascribe all the cells and all the fluid to this one source, but would deem that the

tissue-cells largely proliferate, and in my opinion contribute the greater amount of the cell-formation, etc., which is the essence of a pus-producing inflammation. The synovial and subsynovial tissues are, unlike the parts upon which Cohnheim's observations were made, very rich in cell-elements, and hence, although in the cornea, mesentery, and other parts experimented on, such elements may take a small or even no share in suppurative actions, we cannot therefore deny to more largely gifted parts actions to which they seem peculiarly fitted. I would then hold that both the vessel theory (Cohnheim) and the tissue theory (Virchow) are true, as far as the synovial membrane and its immediate surroundings are concerned, and I cannot but think the latter takes the larger share.[1] Certain is it that not merely the blood-vessels, nutritive channels, and lymphatic rootlets, but also the tissues participate in the process, while the intense pain that precedes the formation of pus would seem to show that other nerves besides the vaso-motor are involved in the action. The pathological and histological narrative of a case unchanged by surgical interference runs as follows:

At first, inflammation, with hyperæmia, intense redness, spots of chemosis and cell-proliferation in the synovial membrane itself and in the peri-articular tissues; the inner surface loses its polish and becomes slightly roughened; in fact the whole condition is that described at p. 56, Case II. The synovia effused, usually small in quantity, is frequently blood-stained and very generally fibrinous; the fibrin separates in distinct clots, which afterward appear as flocculi. In a very short time rapid cell-accumulation, either from the tissues or from migrated corpuscles, or both, render this fluid opalescent, milky, creamy. The subsynovial tissue is also gorged with fluid, among which are innumerable granules and cells. The structures in the immediate neighborhood of the joint are but slightly infiltrated with fluid; but farther away more and more liquid imbibition is found, and at the circumference of the inflammatory action the effusion is simply a serous or sero-sanguinolent liquid, containing but a few bodies, similar in all appearances to white blood-corpuscles. After a certain period both the semi-solid and the liquid effusion become turbid, and in fact puriform. In severe cases the tissues are so closely stuffed with inflammatory products that the veins passing through them become more or less occluded, the limb-segment beyond the joint is proportionably œdematous, while the smaller skin-veins are abnormally full. About this time the limb assumes false positions, of which more hereafter.

The above changes occupy, giving margin for the most and for the least acute cases, from three to eight days. The next phases bring on augmentations of these events; more pus-forms in the joint, the fringes of the synovial membrane hypertrophy and form arborescent,[2] papillary, warty growths, which intrude into the cavity and overhang the cartilages. The peri-articular structures, viz., areolar tissue, capsule and ligaments, become softened and more or less absorbed; the fibres of which they are composed are separated or changed into new soft inflammatory material; and abscesses, not at this period communicating with the joint, form in that neo-

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[1] This is hardly the place to discuss the largely ramified doctrines of inflammation; the reader is referred to the fine works of Dr. Burdon-Sanderson, to Virchow, Cohnheim, Von Recklinghausen and others. Drs. Hüter and R. Böhm have also made special studies of inflammation as it affects the synovial membrane, but the impossibility of watching the process, as in transparent tissues, has prevented these observations leading to definite results.

[2] See a beautiful specimen in the Museum of the College of Surgeons, Pathol. Series, No. 899A. For a fuller account of these growths see Chapter VIII.

plasm. Muscular contractions are no longer equable, but also spasmodic, the jerks occurring chiefly when the patient is falling asleep.[1]

In a few hours more the joint-cavity is filled with pus to distention, almost to bursting. Cases are on record of entire recovery from this stage without leaving trace of the severe condition. It is therefore evident that disease may even reach thus far without of necessity destroying or even permanently affecting the cartilages; but such recoveries are among the rarities of surgery, for at this period those structures are nearly always pretty deeply affected, being, like the other tissues, inflamed. The pathological anatomy of chondritis will be discussed in a separate chapter. I would here only point out that the parts most involved are, on both bones, those that have been subjected to mutual pressure; at these places deep inflammatory ulcerations are frequently found, while other parts remain slightly or not at all affected. These ulcerations are considered by some pathologists as merely passive phenomena; the view is erroneous, as a simple section through the edges of the ulcer, or, still better, a section tinged with nitrate of silver shows cell-proliferation as markedly developed, or nearly so, as can be found in the synovial membrane itself. In other parts of the joint-surface, a considerable district of the cartilage, together with the articular lamella, may separate bodily from the underlying bone and lie loose among the proliferating outgrowths from the synovial membrane and the pus in the cavity.

The next phases bring with them rupture of that pus-secreting granulating tissue which now occupies the place of the synovial membrane. The pus from the joint may now mingle with peri-articular abscesses, or, passing into previously healthy spaces, set up new foci of suppuration, and diffuse itself more and more among the inter-muscular septa or immediately around the bone, often at a great distance from the seat of disease. The cartilages being ulcerated throughout their thickness in some places, while in others they are shed away *en masse*, the cancellous structure and cavities lie open to the joint. This structure also suppurates and becomes carious in some places, granulates in others; the result, pus or granulation, mingling freely with the like products of the synovitis. At this stage little or nothing that can properly be called a joint remains; there is an abscess with walls partly bony, partly fibrous, lined by a granulating membrane, now pyogenic, once synovial. It is perforated in probably more than one place, allowing its puriform contents to mingle with other abscesses, more or less sinuous, in its neighborhood. Any of these abscesses may open on the surface, in acute suppurations, generally close to the focus of disease.

If recovery, of course with a stiffened joint, now set in, it will be by contraction and emptying of these abscesses; the place of the pus is taken by fresh granulations, which fill the cavity, while the older ones, contracting as they organize, squeeze the fluid away. At last, when the abscess is filled up, a sort of cicatrization occurs; the former embryonic cell-material becomes at first fibrous, then osseous tissue, leading to false and true anchylosis respectively. The subjects both of the shedding of cartilage and of fibrous anchylosis, are fully discussed in other chapters; but I must say here that the term necrosis, sometimes applied to cartilages cast off

[1] I shall have occasion hereafter to show that the advent of these "starting pains" coincides with the spread of inflammation to the cancellous structure immediately underlying the articular lamella.

during the process of inflammation, is a misnomer.[1] A necrosis, or slough, is a dead portion of the body; the essential idea involved in that term is death. The portions of cartilage separated in these diseases are quite healthy at the time of separation. But the bone underlying portions of the joint has primarily or secondarily succumbed to the effects of inflammation; the articular lamella is separated, and with it the cartilage of incrustation must perforce fall away. If this process have been rapid, the latter structure is quite healthy; if less quick, an amount of fatty degeneration or of inflammation commensurate with the slowness of the process, may be detected. Always on examination of the deep, the hitherto-attached surface of the cartilage will be found gritty and rough, not unlike that of emery cloth. This grittiness is produced by the articular lamella, which has come away, not in its entirety, but divided into little short prisms, by cleavage along those wavy lines of fibrillation already described (p. 5). The bases of these prisms are of all shapes, from the triangle to the dodecahedron.

The production of fibrous anchylosis, and therefrom of true anchylosis, is in this wise: When granulations sprout from the bone-cancelli, they spring from the lining membrane of those cavities, which of course clings to the bone-lamellæ. Therefore, when two sets of granulations from opposing bones meet, the real state is that, from the edges of one set of cancelli to those of another, lines of soft tissue run. These lines, though they may be obscured by their very softness and decussation, form a minute articulation; while the interstices of the lattice-work are filled out with a newer, probably softer progeny. Yet when fibrillating contraction takes place, these different lines, becoming more solid, define themselves; the meshes hitherto filled with embryonic cells are cleared, and become the tissue meshes of dense areolar structures; thus is left an interlacing fibrous network, running from the edges of cancellar lamellæ of the one to those of the other bone; and, as, like all cicatrices, this material still further contracts, it binds the two altered joint-ends more and more tightly together. If in process of time this tissue ossify, the interlacing fibres become the walls of new cancelli, continuous, both as to their cavities and as to their parietes, with the older ones inside the normal bone.

But there may be no attempt, or at least none but futile attempts, at these reparative processes; then, on the contrary, increasing and continuous suppuration still further exhausts the patient, who, if he still retain the joint, dies, if the malady be quite acute, of exhaustion, probably combined with pyæmia; if more chronic, of hectic and of lardaceous disease of the viscera, or other such complication.

The few words which must here be said (the subject is treated in the sequel) concerning false positions of joints and subluxations have been deferred in order to leave the course of our narrative uninterrupted. Very little is known of the causes which produce abnormal or strained postures. M. Bonnet's explanation, that the limb assumes that position which permits to the synovial membrane its greatest capacity, is insufficient, since the posture assumed is frequently that which diminishes this cavity nearly to the uttermost. The explanation that the limb tends to the side of the more powerful muscles is probably correct as far as it goes, but it does not account for all the phenomena. Ease, that is to say a supposed instinctive

[1] There is such a thing as necrosis of cartilage, but this is probably non-inflammatory; it gives rise of itself to no symptoms, very rarely extends through the whole thickness of the structure, and never involves the lamella. (See Chapter IX.)

choice of that posture which is least painful, is a quite untenable theory, since the most severe of these pains are only to be relieved by entirely changing the position.

The partial or complete dislocations attending this disease are the result of some extreme malposture, or more commonly of irregular muscular contraction acting upon a joint whose uniting ligaments have become too disorganized to resist its effects. The joints of the lower extremity, especially the hip and knee, are most liable to these displacements ; but in one case of traumatic suppuration of the elbow I found the radius dislocated forward on the anterior surface of the humerus. At the hip-joint, when acute suppurative synovitis occurs, a rare event, the head of the femur leaves entirely the acetabulum, and lies generally on the dorsum ilii. The knee, when flexion has been allowed to persist, is subject to one of two subluxations, namely, posterior, in which the tuberosity of the tibia is drawn into the popliteal space, and, far less common, lateral, in which that bone is thrown outward, so that its inner surface receives no longer the internal but the external condyle of the femur. With this a certain amount of posterior dislocation is usually combined.

Symptoms.—If suppurative synovitis make its appearance as a sequela or exacerbation of acute sero-synovitis, the change in the character of the inflammation is ushered in, or closely accompanied by, considerable increase of pain and of fever, which is often, though not always, preceded by a distinct rigor. Then the comparatively slight symptoms of the one disease give place to the far graver ones of the other. More usually suppurative synovitis commences at once as a severe malady, and marks its character both by general and local symptoms before, probably, a drop of pus has formed either in the joint-cavity or in the tissues.

A rigor, usually a pretty severe one, preceded by a certain period of *malaise*, is followed by intense pain in a joint, probably an injured one, which almost immediately begins to swell. Pyrexia, marked by a temperature of 100° to 103°, or even more, at once sets in. The kind of swelling differs from that of a simple synovitis, as described at p. 31. It is rounded ; the depressions marking the site of ligaments, tendons, etc., being filled up, the whole form is more shapeless, and the texture is doughy, pitting superficially on prolonged pressure. The skin, unless the joint be deep, is rather red or pink, not uniformly, but in somewhat foliaceous patches, most marked where the absorbents are chiefly abundant ; between these patches the surface looks white and sodden. The blush readily disappears on pressure of the finger-tip, and returns slowly. If the disease have been caused by a wound, the diagnosis is greatly facilitated. At the period of the rigor, or shortly after, the orifice, from which synovia previously flowed, unless it be closed and covered with collodion, or other such material, becomes dry ; the subcutaneous tissue pouts through the opening, and is either livid or unnaturally pale ; if granulations have already formed, they shrivel, and when the fever is fully established, entirely disappear, leaving a naked raw surface, with, until pus forms, a dry and harsh-looking aspect.

The surgeon will, however, be obliged in mercy to restrict his examination as much as possible, for by this time, viz., from fifteen to thirty hours, in pronounced cases, the pain will have become exceedingly severe ; the patient dreads any movement of the limb or even any contact ; with frightened gesture he waves off the approach of the surgeon's hand ; often, indeed, he will warn the attendants not to touch the bed, or beg them to walk softly lest they shake the room. This pain, though constant, has periods of exacerbation, which chiefly occur at night, when the tempera-

ture will rise ; it is variously described as rending, bursting, or burning ; whatever other character may be noticed, it always presents a sensation, as though the bones were being forced or wrenched asunder.

In from three to five days, during which time, in bad cases, the distal segment of the limb will share in the œdema, and even show a more marked and more superficial effusion, starting pains, an important symptom, of which more will be said in the sequel, commence, and rapidly increase in intensity, while malposture of the joint will arise. These positions are, of course, special to each joint ; and it is very rare to find any inflamed articulation vary from its own peculiar faultiness of posture : they are hardly marked in the joints of the upper extremity, since the forearm held to the side, or the rectangular position of the elbow in diseases of those joints respectively, offers no especial peculiarities. Suppurative inflammation of the hip produces marked flexion of the thigh or the abdomen, with, at first, outward rotation and abduction ; but these two latter postures are often modified by the appliances, cushions, or pillows, used to support the limb. The most frequent position of the unassisted patient is lying on the sound side, with the limb of that side nearly straight, while the diseased thigh, very considerably flexed, is thrown over the other, and rests with the inner condyle on the bed. When the knee is acutely suppurating, that joint becomes more or less rapidly flexed ; at first moderately, then to a right angle, and if still unsupported and uncared for, will go on bending until the extreme of flexion is reached, the heel almost touching the buttock. At the same time a certain amount of subluxation is commonly evidenced by unnatural prominence forward of the condyles and abnormal retrogression of the tuberosities of the tibia. The favorite tendency of a patient left free to choose his own position, is to lie with the body almost supine or a little turned on the diseased side, the thigh bent on the abdomen, the leg on the thigh, and the whole limb rotated outward, so as to rest with its outer surface on the bed. Patients suffering very severely, or who are very sensitive to pain, either turn the body over toward the diseased side, or do not rest the limb in the manner above described ; but grasp it with both hands just above the knee, endeavoring thus to guard it against any movement or shake. The ankle thus inflamed takes a mean position between the right angle and the extreme of flexion. These postures, whether, as at the knee or hip, abnormal, or, as at other joints, not of themselves unnatural, are very fixed, the fixity being more distinctly morbid than the mere position. The slightest attempt on the part of the surgeon to alter them elicits severe pain, and often (always if the patient be a child) loud screams, while the muscles, either by reflex or simply emotional contraction, resist such attempt to the uttermost.

This fixity is always accompanied by wasting of the limb, so rapid that one may see the difference in size on consecutive visits. He who is not much accustomed to such maladies is rather apt to interpret the change of form as produced by increased swelling of the joint. Certainly, such circumstance may aid, but after the third or fourth day, the appearance is chiefly due to the diminution of size in the limb immediately above the articulation. The amount and rapidity of wasting are always commensurate with the abnormity and fixity of posture, and afterward with the severity and frequency of the starting pains : the emaciation is much more quickly and completely exhibited in the limb-segment above than in that below the joint.

The pyrexia is, as has been said, at first of the inflammatory type ; the thermometer, although it may rise a little at night, and slightly fall in the

morning, remains very even, being in the slighter cases about four, or in more severe attacks, about seven degrees above the norm. In a few days, more or less, according to the intensity of disease, its indications change; the temperature line on the chart becoming very uneven and sharply serrated; in the morning falling below 100°, even perhaps nearly to the norm, in the evening running up to 104° or 105°. At the same time the pulse becomes small, quick, and thready, the tongue covers itself with a brown fur, chiefly at the back and along the raphe. These symptoms mark the approach or advent of a typhoid condition.

The surgeon who sees his patient for the first time in this phase of the disease, has a very difficult prognostic problem to solve. The possibility of cure, with mobility intact, or but slightly affected—of cure by anchylosis—the necessity of serious operative measures at once or in the immediate future, are alternatives which present themselves for consideration. Although in all these cases the prognosis must be very doubtful, indeed grave, yet it must be remembered that occasionally an articulation, even so far advanced in suppurative inflammation as the symptoms above described would indicate, may, by judicious management, be led back to a healthy or nearly healthy state. In other cases the best that can be hoped is anchylosis, either true or false.

The elements whereon judgment must be founded are general and local. The former are the duration of the malady, the persistence of the starting pains, the intensity and mode of pyrexia. Thus a disease in which very acute symptoms have only lasted from three days to a week, or longer, if less severe; in which the pyrexia, high from the first, has not continued to increase, and more particularly if the thermometer chart do not represent abrupt and high waves of variability; in which inedia and occasional profuse sweats at night, together with slight sensations of chill, are absent, or nearly so; in which the starting pains are of recent date, and have not increased in intensity and frequency;—such a disease may still be quite capable of cure if the local symptoms be favorable.

Favorable local signs consist in absence or decrease of œdema in the limb-segment below the joint, absence of greatly enlarged surface veins, of increasing intra-articular fluid, or of increase either in size or color of the red patches in the site of the lymphatics. Of course, if to these decrease of one or more symptoms be added, greater hopefulness may be assured. But no more than a remotely probable view of the future can be obtained, unless opportunity for a complete examination of the joint be afforded; and this is hardly possible without the aid of an anæsthetic. Such adjuvant will in all probability be needed merely, as we shall see, for the sake of treatment; and the surgeon should seize the occasion to make, not a rough or too greatly prolonged, but at least a thorough examination of the limb. The points of chief prognostic value are the condition of cartilages, bone, and ligaments, especially of the two first. Even when the patient is quite insensible, so as to leave us at entire liberty to grasp and move the joint, some difficulty will nevertheless attend our attempts to form any certain conclusion on the condition of the cartilages. Any grating which can be defined as osseous is of course conclusive as to breach of substance; but there are many discernible friction-symptoms easily mistaken for bony grating, and there are forms of cartilaginous destruction which do not grate; there may even be ulcers quite through the cartilage, from which no bony grating can be produced, because the opposite surface is still protected by its normal covering. Yet a joint which can be straightened or bent with that perfection of frictionless motion characteristic of these

mechanisms, is hardly likely to be the seat of cartilaginous ulceration. Add to this, the absence, or the very recent appearance of starting pains, or of any strongly marked malposture, and we may conclude that the morbid processes have not yet produced irreparable mischief. Our further judgment of probable events, whether, namely, we may or may not reasonably hope for amelioration, depends upon our appreciation of the general signs above given, among which an almost level and not ascending thermometer, combined with youthfulness, are not the least important.

If, as is unfortunately only too possible, the case do not tend to recovery, it may take one of two courses: it may continue, or even increase the rapidity of its course, or it may assume, though still remaining suppurative, a more chronic character. In the former event, the malposture, unless it have been remedied, becomes more and more marked; the fluctuation of intra-articular fluid more evident, while a tendency toward rupture of the synovial membrane is usually marked by disproportionate increase of swelling in certain directions, as, for instance, at the shoulder in front of the joint, at the elbow just inside the triceps tendon, at the wrist between the ulna and common extensor tendon, at the knee over the subcrureal bursa, at the ankle in front of the outer malleolus.[1] Abscesses form in the periarticular tissues, which may be quite without communication with the joint; may have originated in rupture of the membrane, or having been at first independent, may afterward become part of the joint-abscess. Those independent of the joint may form in any part of the circumference; those resulting from perforation of the capsule have not only their places of predilection as above detailed, but in their further course they often extend great distances; they follow almost always the same directions, being compelled thereto by the disposition of fasciæ, inter-muscular septa, etc.

Even now the limb may still be saved, though with anchylosis; generally true, often false. The first appearance of a tendency to get well will be decline of pyrexia and pain, return of appetite and sleep, while the old abscess-openings, now reduced to sinus mouths, discharge less and less, and then heal, the swelling diminishing more and more. But if the disease still persist, increase rather than diminution of the discharge sets in, the one bone becomes movable on the other in abnormal directions; as, for instance, the ulna and the tibia may be shifted laterally on the humerus and femur respectively, while a probe passed into the sinus may detect carious or necrotic bone; in fact, the whole joint becomes disorganized, and the patient is exposed to all the dangers of hectic or pyæmia.

Treatment.—All wounds which penetrate into a joint require the same form of treatment, modified only to meet the exigencies of puncture, incision, or laceration; but a puncture or short incision must not at once be set down as an opening into the joint, even though it give exit to synovia. The presence of bursæ (not communicating) about many articulations, as, for instance, the knee, must be taken into account; their position, having been already mentioned, requires no further description here. If, after due examination, no definite conclusion be possible, the case must be treated on the worst supposition. In the first place, entire cleanliness must be ensured by an antiseptic injection, and I hold a three per cent. solution of carbolic acid, used warm, to be the best. If the opening be merely a puncture, this should be slowly injected with a small-nozzled syringe; the joint should be filled so that at all events the fluid, when the procedure is completed, dribbles out, and may be caused to flow more rapidly on pressure. After leav-

[1] The hip lies too deep to permit us clearly to define a spot.

ing the liquid in the joint about a minute, it may be gently pressed out, and, if feasible, the limb so placed that the wound is dependent. As soon as the joint is empty, or nearly so, the puncture is to be covered with antiseptic gauze, and dressed *secundum artem*. Much the same means are to be taken if the synovial membrane have been laid widely open; but since in such cases a quantity of gravel, shreds of clothing, or other foreign matter, may have been introduced, the wound should be carefully examined, any impurity removed with properly asepticized instruments, or fingers—even, if necessary, a finger may be passed into the membrane to feel for foreign substances. When entirely cleansed, the joint should be filled with carbolic acid solution, sutured if necessary, and properly dressed. Now comes the consideration of immobilizing the limb. I have had cases of joint-wounds which have done perfectly well upon a splint—such as that described in the previous chapter—also cases that I have treated by plaster-of-Paris with equal success. I do not think the particular appliance is of any consequence as long as the joint is *really fixed*. The gypsum has a decided drawback, for if the joint become painful, suppurate and swell, it may be necessary to remove the appliance at a time when every slightest movement causes exquisite pain. Therefore I generally use one of the forms of splint already described, made more completely effective by using a bandage soaked in a thin solution of gum, dextrine, starch or water-glass, leaving the wounded joint more or less accessible. With this, or with the simple precaution of a sufficient aperient, the patient should be left. Any kind of joint-wound, save perhaps the merest prick, should be immediately treated by ice; at the very least, and in all cases, it should be at hand for prompt use, should any inflammatory symptoms commence. If suppuration arise, the treatment will be like that used in the non-traumatic form of the disease, and this, whether it begin at once on a previously healthy joint, or be a sequela of simple synovitis.

The general treatment will begin with a rather sharp purgative, partly because it is well, whenever a rapid surgical pyrexia commences, to be sure that the primæ viæ are not loaded; secondly, because it is advisable to have this part of the matter done with before the period of most acute pain commences; thus obviating the necessity for any great amount of disturbance during that phase. From a scruple to half a drachm of the compound jalap powder, with some compound spirits of ammonia; five grains or more of the compound colocynth pill; or, in young and weakly persons, simply a rhubarb pill or draught, will be the formula generally advisable. Then, as the thermometer tends to run up, an effervescing mixture of citrate of ammonia (Formula I.) or acetate of potash with acetate and carbonate of ammonia, combined, if the pulse be full and bounding, with ipecacuanha wine, tincture of digitalis, or potassio-tartrate of antimony, will be the most efficacious means of lowering the temperature; caution, however, must be used, lest at the same time we lower too much the patient, especially if the last-named drug be exhibited; and this caution applies, not only to the dose, but to the period of its administration; from twenty-four to seventy-two hours—according to the strength of the patient—should not be exceeded. I also have thought that tincture of aconite in minim doses has proved beneficial, if used so early as to be rather a prophylactic than a remedy; but the uncertainty of deduction in such circumstances need hardly be pointed out. After this first period the treatment must rather incline to the stimulant and tonic form, for, be it remembered, the malady is one which will call largely on the patient's strength and endurance. He will have to be backed up, not merely for present exigencies, but for a

rather wide future. Some form of narcotic will be always necessary, and there can be no doubt that, though we may occasionally be driven to such expedient, the worst way of administering these remedies for local pain is by the mouth ; the best by the subcutaneous tissues. They may also be given per rectum. Experience has convinced me that when hypodermic medication was first introduced we made too large a difference in the doses given by the mouth and by the skin, and that we may without danger employ almost equal doses ; again, that if very severe pain urgently require morphia, it is better to give such a dose as shall surely act, than one which shall only confuse the patient's ideas, but not destroy the pain, and leave him on the morrow tired, head-aching from no sleep, or half-sleep, feeling all the evils of, and no benefit from the drug. The dose for an adult must depend on the amount of pain. If this be moderate, one may inject $\frac{1}{3}$ grain of morphia ; $\frac{1}{2}$ to $\frac{3}{4}$ grain if it be severe ; but often it is better to combine a drug which, besides acting as an anodyne, stimulates the respiratory centres. Thus I prefer $\frac{1}{3}$ grain of morphia and $\frac{1}{100}$ grain of atropine, or $\frac{1}{2}$ grain of morphia with the same amount, or with a smaller dose of atropine. (See Formula VI.)

The local treatment must be regulated by the condition in which the surgeon finds the limb. If, on his arrival, no malposture and no fixity of position have commenced, he must at once place it on a splint, or, if he prefer, in plaster-of-Paris, in the postures and with the precautions already given (p. 36). Let him, if either elbow, wrist, knee, or ankle be involved, swing the limb. The amount of comfort which the patient gains by this arrangement can hardly be overstated. If the joint have become fixed in some of the malpostures, described at p. 34, it is the first and most imperative duty of the surgeon to reduce the limb to a proper position. I am not in any way exaggerating the benefits of this treatment when I say that of commencing suppurative synovitis a good number of cases may be led to a fortunate ending if this point be at once attended to ; if it be neglected or overlooked, most, if not all, will end badly. Moreover, as I have again and again witnessed, pain which has been of the most severe and unmanageable description while the joint is in malposture, will either almost entirely disappear or become quite amenable to moderate treatment, when the limb has been put into a good position. A further importance attaches to this matter, namely, if the limb be left in an awkward posture, and if, in spite of such error, the patient recover with an anchylosed joint, his limb will be very useless, unless some further surgical procedure—not always successful—be adopted ; whereas we may avoid such necessity, if, during the malady, the limb be placed in that posture which will be, in case of fixation, most convenient to the patient. To effect this re-position of the joint, ether or chloroform must be given, so as to induce a rather deep narcosis. No force will be required early in the case to rectify the posture ; even subluxations will, under skilful management, disappear. A splint must then be applied while narcosis continues. The proper splintage for different joints have already been described. I need only add, in regard to the hip, that great care must be taken that the thigh is really straight on the pelvis, and that no ambiguity produced by mere incurvation of the loins deceive us. (See Chapter XIV.) Probably some form of extension will afterward be desirable.

When all this has been achieved, further local treatment requires our utmost care, and much will again depend on the stage of the disease : if it be still early, that is, as well as can be judged, before pus has actually formed, much may be effected by a powerful revulsion. Cantharides in

any form is useless. A line drawn on each side of the joint with a very hot—a white hot—iron has, in one or two instances under my care, proved efficacious. Petrequin's cautery is the best instrument for this purpose; or, again, the joint may be painted over with a concentrated tincture of iodine (Formula).

But all these applications have this inconvenience, if they do not cure, or almost cure the disease, either because the phase has been mistaken, or because it is from its onset too obstinate to be thus eliminated, they leave sores and troubles behind them which add to our difficulties, and to the patient's sufferings. I prefer therefore, in nearly all cases, cold, a rather intense cold, by means of ice broken into small pieces, put into a wide-mouthed india-rubber bag, applied immediately to the skin, and changed sufficiently often; we may even increase the cold by adding a little salt. The inconvenience of weight may be obviated by partial suspension; but care must be taken that a good large surface is in contact with the bag. After a very few seconds—the first impact of the cold is often disagreeable—a decided sense of relief is produced by this application.

If in spite of this treatment, the signs of suppuration in and around the joint still continue, it becomes desirable to evacuate the fluid. This may be done, as is sometimes recommended, by means of a trocar and canula; but I do not approve this method, because a mere puncture does not as a rule sufficiently empty the joint, relieve the peri-articular tissues, nor give exit to shreds and flocculi, nor, in a late phase, to any fragments of shed cartilage.

In 1851, Mr. Gay advocated free incision,[1] which, indeed, had been previously proposed by Petit, Boyer and others, though it had fallen into disuse chiefly from dread produced by the result of wounds penetrating into sound joints. There is, however, no real analogy between these two conditions; a suppurating joint is no longer a cavity enclosed by a membrane, sensitive, as is synovial tissue, to every pyrogenous influence; but has become simply an abscess-cavity surrounded by an embryonic tissue (pyogenic membrane) analogous to, if not identical with, granulation tissue, and not peculiarly sensitive to impressions from without. Hence such a cavity may be laid open with the same safety, but also with the same dangers, as any other deeply seated abscess; the safety lying in its indifference to ordinary stimuli, the danger in the tendency of pus lying in large, deep, and complicated cavities to putrefy, and to give rise to secondary troubles, such as septicæmia or pyæmia. These dangers may all be obviated by antisepticism well and thoroughly carried out, and under this mode of management acute articular abscess ought to be laid open by one or more free incisions much earlier than can be advised, if the cavity must be exposed unprotected to the air. A joint which evidently contains inflammatory pus, *i.e.*, not a mere surface-secretion (p. 29)—and the diagnosis must depend chiefly on the systemic symptoms—ought always to be thus emptied when the temperature is found not to decline, more especially if the pain continue severe. The shoulder may be incised parallel with the fibres and through the front portions of the deltoid, beginning close to the acromion process, and terminating short of the neck of the humerus, so as to avoid the circumflex nerve. The elbow had best be opened at the junction of the radius with the capitellum by a transverse incision, and if the size of the abscess seem to render it necessary, this simple line may be converted into a T incision by another along the outer border of the ole-

[1] Medical Times and Gazette, vol. xxiv., p. 546.

cranon. The wrist may be laid open anywhere at the posterior part, but most advantageously by an incision along the course of the extensor minimi digiti tendon. The hip is rarely affected with acute suppurative synovitis, but when this occurs, there is great danger of spontaneous dislocation; an early opening should therefore be made, but I am hardly prepared to advise a free incision into this deeply seated joint, though in severe cases I should not hesitate to do so, if a cutaneous puncture with a tenotome and a wide incision of the capsule should fail to give relief. At the knee-joint the best plan is to make two incisions, the one just in front of the internal, the other of the external lateral ligament. For the ankle an incision in front of the external malleolus, and if necessary of the internal also, may be made. The anatomy of some joints precludes the possibility of making incisions in the most depending parts, and the after-treatment, which chiefly consists in careful washing out, is in such articulations doubly necessary. All suppurating joints thus treated by incision must be carefully syringed twice or thrice a day. The best mechanism for this purpose is Esmarch's, which I can best describe as a metal can or pot suspended some height above the bed, having at its lower part an opening, to which an india-rubber tube terminating in a canula and stopcock of proper size, can be affixed. The best fluid for washing out joint-abscesses is carbolic acid—a three per cent. solution; it is far more reliable than the thymol. The canula must be so managed as to insure contact of the liquid with every part of the joint. The off-drain can easily be arranged by properly folding mackintosh sheeting so as to leave a channel or spout leading to a vessel on the floor. To the part, when dressed, ice-bags may be applied outside the bandage; or if the general condition be depressed, and the tissues passively congested rather than inflamed, cold may be omitted, or even warmth may be substituted.

By such treatment joints thus diseased may be saved, occasionally even restored with their functions restrained, rather than injured. More often the cure is by anchylosis, of which hereafter.

Occasionally, however, despite the most careful and skilful treatment, neither the joint nor the patient gets better. In spite even of incisions, acute suppuration may continue; the temperature keeps high, and rises still more in the evening; the tongue gets brown and dry; the appetite entirely fails; and the patient, living perhaps chiefly on stimuli, becomes rapidly exhausted. In such case, to save life, amputation is an unfortunate necessity, which, in such a bad condition of affairs, the surgeon must always have in his mind, watching for any signs which may still induce him to try and save the limb; yet also very careful lest he postpone operation so long that he jeopardize its success. In other cases the violence of the disease may have been subdued, and yet the joint continue to suppurate, and not the joint only, but the limb in the neighborhood and at a distance. Here, too, the surgeon must determine if and when amputation may be absolutely necessary, but the slower march of the disease will give him opportunity for more leisurely consideration; he will try whether counter-openings in various parts, injecting with carbolic acid, bandaging toward the opening with narrow pads fitting over the tracks of the abscess may not diminish the discharge and induce healing. If all these measures prove useless, and if he find either that the abscesses will not heal or that fresh ones continually form, he has but the one resource, and must not too long delay. I would also point out and lay considerable stress on the statement that cases of this sort are the less hopeless if the abscesses be somewhat superficial. Abscess among the deeper muscles of a large limb, as the thigh, especially

if it run not downward but *upward* from the diseased joint, is of less good import. Worse than any other, and indicating earlier amputation, is suppuration, running along the bone and extending farther and farther up the limb, with little or no tendency to come to the surface.

I subjoin a case, to show that wounds of joints, even though no antiseptics be used, are not of necessity followed by synovitis; but by no means to recommend such omission.

Case VIII.—On March 14, 1859, I saw H. L., a young woman upon whose knee a boil had that morning been so incautiously incised, that it was feared the joint was opened; the circumstance leading to this suspicion was an escape of synovia. The boil was close to the ligamentum patellæ, close to and running parallel with which was an incised wound, a little more than an inch long, from which synovia oozed, and when the leg was bent, flowed pretty freely. This flux proved nothing, since, although rather plentiful, it might be produced by the bursa in this situation. I therefore warmed, oiled, and carefully introduced a thin probe, when it sank at once to a depth clearly showing it to have entered the knee. The instrument was withdrawn, a gutta-percha splint placed on the limb, and the wound closed by painting its surface with collodion, and covering it with a piece of soap plaster; the object being not merely to prevent the entrance of air, but also the exit of synovia, which would tend to keep it open. The wound healed without a sign of synovial inflammation.

The next case shows that even a permanent opening may exist without accompanying synovial affection.

Case IX.—Henry Short, sailor, aged thirty-two, was sent to me on April 25, 1859.

He came for ulcers about the right elbow, of which he gave the following account: Three years ago, while at sea between Madras and Calcutta, there broke out on board ship a complaint which he called scurvy-boils. Several of the crew were affected. He had several boils on different parts of his body, the worst being about his elbow, and nearly a fortnight after they had opened into an ulcer, the bone began to get bare. On his arrival at Calcutta he went into hospital, where the sore healed; he says that no bone came away, but in this he must have been mistaken.

There was a large scar, with uneven edges at the back of the elbow, upon which four small ulcerations had reappeared—one in the centre being deep and fistulous. Around this spot the elbow was deformed by a depression, which, judging by eyesight, merely appeared to result from absence of bone. On examining the part more closely by touch, it was evident that a portion of the olecranon was absent; the part still remaining being attached like a sesamoid bone to the triceps extensor tendon; between that detached piece and the rest of the ulna was an interval corresponding to the depression above mentioned, and which varied from three-quarters of an inch, when the arm was straight, to one inch and a quarter when it was bent, and even to nearly two inches when the cubit was strongly flexed. In the centre of this space was the fistulous ulcer already described, out of which synovia flowed freely. When he alternately bent and straightened the arm rather quickly, air was sucked into, then driven out of this opening, with an evident impulse; and at the same time the synovial sac was first separated from, afterward propelled against, the bones of the joint, making a flapping noise, like the dry valve of a pump before the water has

risen. When he had continued this action some time the joint looked a little swollen, and on pressing it with the hands, air could be expelled from the synovial sac. The man experienced no pain nor any stiffness of the joint, and seemed surprised when told to keep it at rest.

The treatment was simply rest, closure of this opening by adhesive plaster, and the internal use of iodine. The ulcers gradually healed; that leading into the joint hardly slower than the others, because all flow of synovia was prevented. On May 30th he was well, and about to start on another Indian voyage.

August, 1860.—This man returned: the ulcer into the joint was again open, but no inflammatory symptom has shown itself.

Case X.—James F., aged sixteen, fell while carrying a bottle down stairs, and received from the broken glass a severe wound on the inner and back part of the wrist. He came at once to Charing Cross Hospital, June 3, 1872. A piece of glass was extracted by the house-surgeon from very deep in the wound, which was sewn up and dressed with plaster; the boy being dismissed with his hand on a proper splint. On the 5th he came back early in the morning. The hand and lower part of the arm were much swollen; the wound was inflamed, white at the edge, and nowhere united. On removing the dressing, some pus, followed by turbid synovia, flowed. He was admitted, and an ice-bag applied. I saw him later, and found him in great pain; the thermometer marked 101.3°; his tongue was coated; skin dry. No action of the bowels for three days. An enema was ordered; support and stimulus, and the ice to be continued.

June 6th.—This morning he had two severe rigors and the wrist became more swollen and baggy; temperature, 102.1°. Two deep incisions were made along the outer and inner posterior aspect of the wrist; the dresser receiving directions to syringe out the wound with the permanganate of potash solution night and morning. He had ten grains of quinine at once, and five grains every six hours.

June 8th.—The wounds were discharging freely a rather dark greenish, thick pus, with occasionally a streak of blood; the swelling extended about a third up the arm; temperature, 102.8°. He had now six ounces of brandy per diem, mixed sometimes with a yelk of egg; strong beef-tea, and other support.

June 11th.—The swelling had receded from the arm, but at the wrist was strongly marked; all the tissues were soft and boggy. On any movement the carpal bones were felt to grate loosely, and, on passing the finger into the wound, could be felt bare and rough. A consultation with my colleagues was held, which ended unanimously in the rejection of excision, since in the state of soft parts it would be likely to lead to some form of blood-poisoning. I therefore amputated as near the hand as possible; the loss of the suppurating joint caused immediate improvement, and the boy made an excellent recovery.

On examining the parts removed, the radius was found bare and rough, a large part of its cartilage was separated from the bone, but only in part ulcerated, the rest remaining attached to the still adherent portion. The carpal bones, except the trapezoid, were soft; some were granulating, others simply necrosed; the cartilages of most of them lay loosely in the abscess-cavity. The synovial membrane had lost all its peculiarities, and was simply a mass of more or less unhealthy granulations; the bases of the metacarpal bones were sound, except that of the ring finger, which was bare and carious.

Case XI.—Master G., aged ten, in crossing Bond Street, was knocked

down by a Brougham-horse with such violence that he was thrown under the wheel of a Hansom cab, that went over his bare knee ; he wore knicker-bockers. This happened on July 14, 1878, about the middle of the day. He was at once taken to the lodgings of his friends, and I saw him within ten minutes of the occurrence. I found a deep wound on the inner side of the patella—that bone was pushed upon the outer condyle, and partially turned round, so that I could see a portion of the cartilage ; the wound was full of dirt. I had chloroform at once administered, and, under a spray of carbolic acid, cleaned with the same lotion all parts of the wound, passing my finger within the joint to remove remnants. The patellar subluxation reduced itself on bending the knee. I put in a drainage-tube, sewed the wound close, and placed the limb on a MacIntyre splint, dressing the wound with gauze.

July 16th.—The dressings removed under the spray. A good deal of synovia had moistened the dressings : with the exception of where the drainage tube passed, the wound had closed ; here lay a clot of blood looking perfectly fresh and pure. The drainage-tube was shortened to about a quarter of an inch, so as not to lie in the joint ; dressing reapplied. The temperature had been 99.4° in the morning, 99.8° in the evening, so little pain that no morphia had been given.

July 19th.—Wound dressed again ; drainage-tube quite removed.

July 22d.—The wound had quite healed ; there was perhaps a little extra synovia in the joint.

August 18th.—There has been nothing to report ; the slight swelling of the knee lasted about a week after last report—to the 28th or 29th ultimo. The splint was kept on another week—to the 6th August—at that time measurement showed no difference in the size of the two joints. I allowed some cautious movement, but let the joint be confined nearly straight in a thick leather splint at night. At the date above given the youth was walking well, but I did not allow much exertion.

I saw him in November ; the knee was perfect. This case, where antiseptics were used, contrasts strongly with the former.

I also give a case to show that such remedies will avail even when some suppurative action has already commenced.

Case XII.—Robert P. was admitted, under my care, about 11 P.M. of December 16, 1879, having a punctured wound inflicted by a knife during a brawl ; the man was very drunk. The wound was not considered by the house-surgeon to have penetrated the joint, but in consideration of its proximity to the synovial membrane the limb was put on a splint. I did not see the patient till the visiting time of Friday the 19th. The man then complained of a good deal of pain ; he had a rigor about 11 o'clock the same morning ; temperature 102.2°. The wound, which was about half an inch long, was gaping ; its edges pouting, flabby, and pale ; knee rather swollen. On pressing with my two hands on the sides and back of the joint, a purulent fluid flowed, and with the last drops so much air as to make rather large bubbles issue from the wound. With a large glass syringe the whole joint was filled with a carbolic acid solution three per cent., and then dressed antiseptically. Some swelling and pain continued for about a week, but nothing to be compared to that he had before the injection ; the temperature went down, and has since remained normal. He was discharged cured on February 27, 1880.

Case XIII.—Louisa S., twenty-four years of age, had been out of health

and feeling generally ill for between two and three months. Three nights ago she was awakened by great pain in the knee: it was swollen; she thinks she sprained it a week before (such *post-facto* recollections are very worthless). She was admitted into hospital under my care March 10, 1875. The knee was very considerably flexed, greatly swollen, pitting slightly, and fluctuating, the patella knocked, but there was also much peri-articular tumefaction. It was difficult to obtain a fair examination, as the patient shrieked even at the approach of a hand. The tongue was furred; temperature, 102.6°. She says she has had no sleep for three nights; has eaten nothing, but is very thirsty. Chloroform was administered, the knee put into a nearly straight posture, an ice-bag ordered to be applied; hypodermic injection of morphia half a grain every night, and if pain were urgent a quarter of a grain at any time; the effervescing citrate of ammonia every four hours.

March 12th.—The patient had not progressed. She was in rather less pain for a few hours after splintage of the limb in good position, but this alleviation was transient. At above date the joint was more swollen, fluctuated, plainly pitted, was red on the inner side in two or three blotches, and in one on the outer—temperature, 103.2°; pulse small and quick, 110. She begged that something might be done for her relief. I laid the joint freely open by an incision on each side; the inner and longer one passing from above the patella almost to the tubercle of the tibia: the one on the outer side farther back, about two inches long and about an inch in front of the head of the fibula. Through both these cuts abundance of pus, mixed with flocculi, came away. This was done antiseptically; the joint-bag being washed out with carbolic acid, and dressed with gauze.

March 14th.—Suppuration very considerable, hardly any pain; evening temperature, 101.2°. A portion of cartilage, about the size of a three-penny piece, softened, fibrillated and sodden, came away.

March 20th.—The joint was much less swollen; the infiltrated and pitting condition was less marked, and the upper end of the inner wound was granulating and contracting. In order to keep the outer wound, the most depending one, freely open, a director was passed in, and the commencing adhesion broken down; some additional drops of pus flowed. The patient was feeble—temperature, morning, 99.1°, evening, 101.7°; sweats at night a good deal. She had been taking sulphuric acid and cinchona; had all possible food and support.

The case was long, and the possibility of saving the limb sometimes doubtful, but about April 25th her powers greatly improved, the discharge having gradually ceased, and the wounds healing; the joint was evidently disorganized, and anchylosis the best termination. On May 13th, I tried passive movement—there was no grating. I ordered motion every day in order to increase the arc, which was very small. The wounds were by this time merely short lines of granulations.

June 17th.—But little further mobility had been gained by passive motion. I had her taken to the theatre, chloroform administered, and endeavored to set the joint free. After gaining a little more in the direction of flexion, I found that to continue this movement would produce too loose a joint laterally; enough, however, had been gained to make the limb very manageable.

July 4th.—Discharged with a healed joint, movable through an angle of about twenty-five degrees; it never can be quite straightened.

June, 1878.—This patient called at the hospital. The knee was sound, and with perfectly free movements within the above limits. She had learned to walk with a barely perceptible limp.

CHAPTER IV.

ON PYÆMIC JOINT DISEASE, AND ON CERTAIN OTHER AFFECTIONS ORIGINATING IN ABSORPTION OF MORBID MATTERS.

Hitherto we have studied inflammations, varying in character somewhat among each other, but all with this peculiarity, that they are distinctly local; that whether or no their origin be traumatic, they are independent of any blood disease. It now becomes our task to examine certain classes of malady produced by and dependent upon changes which have taken place in the blood. These, though rather a symptom than a disease, require at all events so much notice as will suffice for their recognition and comprehension. Constitutional taint, inherited or otherwise, such for instance as gout, rheumatism, struma, have all a tendency to affect the joints; and these will become the subjects of inquiry hereafter. Besides these inborn vices of the system, others, accidental and acquired, influence the blood in such wise as to produce a well-marked pyrexia, with which affections of the joints are often combined. Among these the most important are diseases caused by the action of pus or septic matter introduced into the system. Pyæmia and septicæmia, generally arising in connection with an external wound, or after childbirth, take the first rank among these; but in the same category belong gonorrhœal rheumatism, improperly so called, also the synovitis, arising in the course of enteric fever, dysentery, small-pox, and scarlatina. All these are connected with suppuration and breach of surface, while in measles the connection is scarcely more occult.

The appearances after death of one, who, for instance, having sustained wound or injury, dies, after some hours or some days, of septic fever and exhaustion, are different chiefly according to the rapidity of the disease. In the slower cases abscesses, often termed metastatic, form in different parts of the body; in the more rapid cases this does not always take place. The latter form of disease is termed by many authors septicæmia (septhæmia of Virchow) as distinctive from pyæmia.[1] I regard the difference only as one of degree, and the cause of non-appearance of abscesses in the former merely as want of time for their formation. If, then, an autopsy be made on one who dies of rapid blood-poisoning (septicæmia) in from seventy hours

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[1] The various meanings given by different writers to the terms septicæmia and pyæmia would render my text doubtful unless it be distinctly explained, that by the former term I intend to designate a more rapid disease. It would be impossible in a work not consecrated to this special subject to dilate upon the various theories as to doses of the poison, non-infective qualities of the blood taken from animals dying of the former disease, and of absence of bacteria in that blood. The reader desirous of further information is referred to the writers quoted in the text to Koch's Untersuchungen über die Aetiologie der Wundinfectionskrankheiten, and to the Report of the Pathological Society. 1879. The text makes clear my views, that the difference is of degree rather than that of kind, and I hold that Koch's injected mice bear out this idea, while with some other conclusions, both of that experimenter and of the Pathological Society's committee, I cannot agree.

to a week after the first rigor, there will be found, around the place of injury, infiltration of the tissues with ichorous or foul purulent fluid (whereof further mention will be made), and one or more of the smaller veins leading from the part may be found plugged with loosely formed red, sometimes brownish or grayish clot. In distant parts, internal organs or tissues of limbs, often very little is found. The spleen is very generally large, soft, and easily broken down; and save in cases of very swift death, red and hardened wedge-shaped patches ("blocks") are present—the wedges having their thin edge turned to the centre, their bases toward the periphery of the organ; the liver, too, is somewhat congested and friable. The intestines healthy, unless there have been diarrhœa, in which event the glands chiefly of the large intestines, will be found swollen and red; the peritoneum is generally inflamed. The blood, when one can collect it, is found not coagulated, but as it were inspissated, dark in color and thick in consistence, reminding one of pitch. Besides these appearances, one occasionally finds, on mucous and serous surfaces, spots of purpura-like extravasation.

All this, which has nothing to do with joints, has appeared to me necessary as one aspect of a malady, in which joints are always affected, viz., the slower forms of the same blood-poisoning. If, instead of so rapid a case, we have on the table one who survived the first attack of the disease from forty-eight hours to ten or twelve days, we find, beyond the changes above described, secondary or metastatic abscesses in several places, external or internal, in the lungs, liver, spleen, sometimes in the kidney. Mixed with these are more or less frequent hardened congestions or infarctions, the centre of the older ones breaking down into pus. The serous membranes are reddened in blots or patches, and usually contain a quantity of muddy serum, or simply pus. Often, in the cellular tissue, in deep places among the muscles, abscesses will be found, and generally more than one joint contains pus. Of the condition of these joints I prefer to speak farther on; at present it will be well to confine myself to other features of the disease.

The wound, the neighborhood of a necrosis or of the perimetric tissues, as the case may be, is found darkly congested and infiltrated with sanies or foul pus; and some of the veins leading from the place are frequently, but not always, clogged with clots, some of which may be dark in color, others gray and granular, some broken down, and in their interior purulent; such thrombi have often an evil odor, and appear more or less putrescent. It has been pointed out that the clot plugging a smaller vein protrudes its end into the blood-current of the larger stem into which it opens, and that such end is often broken down, split up into loose fibrils and detritus.[1]

Such finds have led to the theory that pyæmia and its secondary abscesses or infarctions are merely embolic phenomena; that little shreds from the thrombus, falling into the circulation, are carried to distant organs, where they plug capillaries, giving rise to blocks, congestion and suppurative inflammations. That such events may occur in connection with pyæmia is more than probable, but they are only complications, not the essence of the disease. Mere mechanical obstruction will account only for a few of the phenomena. In a large proportion of cases the lungs, where venous emboli ought chiefly to lodge, escape altogether, while in the area of the systemic circulation many secondary abscesses are found. Again, we do not in pyæmia meet with unequivocal symptoms of mechanical obstruction, such

[1] Callender on Pyæmia in the System of Surgery.

as gangrene, cerebral paralysis, etc.[1] Lastly—but this evidence is merely negative — many cases of pyæmia occur in which no blood-clotting can be found in the veins leading from the wound ;[2] although I am bound to say—and it is a matter of very great importance—that even in such cases the tissues around that wound present a condition of unhealthiness evident to the naked eye, but more especially patent to a high power of microscope.

Another condition of the wound and its neighborhood, and one of greater importance, is the presence of minute organisms, which crowd in countless numbers the exudation fluids. Several diseases, both of man and animals, are accompanied (produced?) by the development of minute creatures, viz., in the human subject, besides pyæmia and erysipelas,[3] we find them in vaccinia, small-pox, enteric and relapsing fever. It is also more than probable that future observation will detect them in certain allied diseases of infective origin, viz., diphtheria, scarlatina, measles, and perhaps some others. Two points must be especially noted. Firstly, whatever part these organisms play in the propagation of disease, or in the conveyance of infection, resides in the bodies themselves, and in their spores or germs, and is not shared by the liquid in which they float ; for when strained through a filter of adequate fineness, viz., baked clay-cells, the fluid is quite innocuous (see the experiments of Klebs). Secondly, these bodies or their germs convey only the malady to which they are related ; germs derived from relapsing fever will not produce vaccinia or enteric fever. Thus all diseases of specific character, such as small-pox, vaccinia, and so on, presuppose in each instance the existence of a previous case which hatched and sustained its special organism.

But other forms of minute particles with which we have here more to do are less specific in their nature ; their appearance in the human or animal economy does not of necessity connote the pre-existence of a like disease. They seem more distinctly associated with the earlier stages of putrefaction, multiplying in organic fluids dead and outside the body, portions of which liquid may dry, and the particles previously suspended in it, or their germs and spores, be disseminated through the air, forming part of that dust which we may see in the sunbeam or gather from the walls and furniture of our living rooms. A little of this dust introduced into a properly prepared organic infusion [4] rapidly generates numberless bacteria, and again, with the development of such forms, putrefaction of the liquid is constantly associated ; we may indeed say that in the absence of such development putrefaction is impossible.[5]

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[1] Panum in Virchow's Archiv, Bd. xxv.

[2] This failure to find the venous thrombi has occurred to me more than once, as also to other most careful observers : see especially Heiberg, Ueber die pyämische und puerperale Prozesse, pp. 20–22.

[3] The presence of micrococci in erysipelas is frequent, if not constant. On a subject so difficult no definite opinion should be expressed unless something amounting to proof can be offered ; therefore I can only say here that my investigations at present tend to the view that in pyæmia the living contagion passes into the veins, in erysipelas into the lymphatics.

[4] Or into a certain chemical "cultivation liquid." Burdon-Sanderson, Brit. Med. Journ., 1875, vol. i., p. 70 : "Half per cent. of potassic phosphate and magnesic sulphate with a trace of calcic phosphate, and then adding as required a further percentage of ammonic tartrate, and of course boiling the liquor."

[5] It is only fair to state that Dr. Bastian has shown, I believe, conclusively, since the results are acknowledged by Drs. Sanderson, Gothmerdlen, Loppeseyler, and others, that certain infusions boiled for five or even ten minutes in a tube, and hermetically sealed during ebullition, will, if kept in a certain temperature, develop bacteriæ. Whether

The minute creature, hitherto called a bacterium, is, however, by no means always a little stick or rod; the microzyme, micrococcus, or whatever we may call the organism, may be a rod or a spheroid, and these may aggregate into a "bacterium filament," or a "dumb-bell," or a "chain," by addition of rods end to end, of two or more spheroids in line; even more complex unions are formed by a "colony" of both rods and spheroids kept together by a gelatinous medium. The governing forms in all these are the rod and the spheroid, the former from $\frac{1}{500}$ to $\frac{1}{1000}$ of an inch long, the latter about $\frac{1}{1000}$ of a line in diameter or smaller.

Careful and manifold experiments have shown that some of these spores, which, be it remembered, appear as the progeny of atmospheric dust, and in their separate state are ultra-microscopic, introduced into the tissues or into a serous cavity of an animal, multiply there, and, passing into the lymph and blood, produce well-marked fever; the liquid, or rather the bacteria and germs in the liquid, are "pyrogenous." Moreover, if some of the exudation fluids be taken from that suffering animal, and introduced in like manner into a sound creature, that one will be similarly but more violently affected, and so one may go on to a third and fourth animal, increasing, not in a perfectly regular manner, but still increasing the intensity of the artificial peritonitis and pyæmic fever.[1] The animal, after death, is found to have other serous membranes, besides that employed as the recipient, inflamed; also enteritis, lung-consolidation and, if it have lived long enough, secondary abscesses in liver, lung, and system; all the exudation liquids and the blood itself are vibratile with bacterial movement.

We may now juxtapose with these experiments the symptoms during life, and more especially the appearances after death from pyæmia in the human subject, and sometimes find the same organisms in the exudation liquids in the secondary abscesses, even in the blood of our patients. We may go still farther, and find that the venous thrombi, before mentioned (p. 64), are but crowds of bacteria held together by colored blood-plasma; that the clot, probably, is produced by the organisms, is not first formed and then entangles the bacteria in its meshes. Furthermore, we may see in hospitals where an epidemic of pyæmia reigns, that although, as just stated, the presence of these forms in the human body does not of necessity denote the pre-existence of a like disease in another person, yet the malady is infectious, is, indeed, often conveyed from one individual to another, and the disease appears to gain strength as one patient takes it from a predecessor, just as the series of experimental animals adds each its increment of virulence to the poison. Patient No. 1 may have an open wound in such condition as shall nourish some of the atmospheric dust, that may fall upon it into the bacteroid poison, absorb it, and suffer pyæmia; his evacuations being infinitely more crowded with germs than the adjacent atmosphere, form a new and more potent centre of infection for all other wounded patients in his neighborhood.

Nay, more, I think, we may conclude that certain of these forms are either more pyrogenous, or that they inhabit more completely decomposed fluids, *i.e.*, their presence produces more complete putrefaction than others, their movements are more active, and they are present in greater numbers;

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or no this fact will bear the interpretation that he puts upon it, is a subject that would lead us too far from the matter in hand, as likewise would the controversy between him and Professor Tyndall. I need only say that the general conclusion of science seems to be that certain forms resist a temperature, unless prolonged, which destroys all other forms of microcosms.

[1] Report of Medical Officer of Privy Council, New Series, No. vi. 1875, p. 69 *et seq.*

that is to say, they multiply more quickly, and are much more lively and active.[1]

Here is a wide field for induction, even for some speculation. In the experiments above referred to, a certain virulence of poison, *i.e.*, a certain plenitude of bacteroid forms in active movement, is always, in the same genus of animal, followed by a proportionate ratio of fever; but of two or more patients with the same sort of wound and treated in the same way, one will suffer the severest form of poisoning and die in forty hours; another will have swollen joints, many abscesses and a long illness, from which he may or may not recover; while a third, after one or two rigors and a high temperature, may be well in three days. In the exudation fluids of the first, active rod-shaped bacteria and vibrios will be found, in those of the second and third only a few sluggish spheroids and dumb-bells may be discoverable. Therefore, if all these men have been subjected to the same infection, we must conclude that the one form of micrococcus may, under certain circumstances, generate the other. In the first case spores or germs found a fitting cultivation fluid, not merely in the wound-secretion, but in the blood of the sufferer, and rapidly propagated a lively and productive brood. The fluids of the second, in a less receptive state, permitted less active multiplication; those of the third a still slower development. Or again, the two last or the last alone may be credited with some power of excretion, adding a further protective power against this form of infection. The clinical fact, so often witnessed in ill-regulated and pyæmia-stricken wards, that different patients, similarly situated in all external circumstances, are affected in such various degrees, appears open to no other interpretation, if we accept the light of experimental pathology.

The result, then, of combining experimental and microscopical research with clinical observation, is that septic poison (which I hold to mean infection by micrococci or their emanations) is administered by nature in different doses and in various degrees of strength. The septic *materies morbi* is probably but one in kind. The variety in the effects is due in part to the intensity of the poison, but probably more to the receptivity of the individual (the state of his fluids). We know that certain persons are more prone to this poisoning than others; also that certain conditions of body render any one, not previously prone, very sensitive to septic influence.

Such is the probable history of the origin of pyæmia, in most cases of open wound or childbirth, surrounded by a more or less vitiated atmosphere, or subject to the intrusion of unclean fingers and infected dressings. The presence of bacteroid germs in the air and in the dust has been pretty closely demonstrated by Pasteur, Klebs, Sanderson, Tyndall, and others; the door for their admission into the system stands wide. But we must not let the simplicity and apparent completeness of the narrative mislead us, for it will not account for all occurrences, for cases of pyæmia without external wound, for its idiopathic forms, for its arising in connection with osteo-myelitis and other diseases, in which no means of ingress for bacteria exist. We know that in these cases the exudation fluids are as much charged with microzymes as when we may trace them to a wound, but the means of their advent is unknown. On this point experiments on animals serve rather to increase obscurity. In sensitive creatures, as guinea-pigs,

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[1] Dr. Sanderson computes that of one of the more active forms "every bacterium must produce 16,777,220 individuals in twenty-four hours. Putting it otherwise, the progeny of a mass of bacteria weighing $\frac{1}{24000}$ of a grain would, at the end of the day, weigh a pound."—Brit. Med. Journal, 1875, vol. i., p. 70.

or rabbits, an intense peritonitis was excited by injecting iodine, or diluted liquor ammonia, previously boiled to free it of any germs, with a syringe similarly treated, and in every instance it was found that the exudation liquids collected from twenty-four to forty-eight hours after injection were charged with bacteria,[1] and the fluid thus charged served to excite intense blood-poisoning when injected into another animal.

The object of this work will hardly be served by endeavoring to trace the origin of the bacteria produced in such experiments, nor in the cases of human unprovoked pyæmia. It is certain that in man the pus of ordinary abscess of ulcers, etc., is free from microzymes, nor is their development to be induced so easily, as in guinea-pigs, rabbits, and other creatures very sensitive to infective disease. When the health is depressed, a part of the body long subject to suppuration, or the action intense, especially when bone is the tissue inflamed, bacteria, whatever their origin, do undoubtedly develop, and with their development comes pyæmia, potentially or actually; yet, occasionally, as shown by Billroth,[2] abscesses, whose whole course and development are quite innocent, have been found crowded with bacteria at the very moment of their exposure to the air.[3] Nor, again, must we lose sight of the fact that occasionally cases occur, in which no evident connection can in the autopsy be found between organisms in a wound and pyæmia. The postponed examination, necessary in dealing with the human subject, gives ample time for the development of low organic forms in open wounds after death, or during a prolonged act of dying; and I know by experience that in many bodies, death having been in no wise pyæmic, we may, at the time when the post-mortem is made, find numbers of microzymes even in closed bags such as the pericardium.

Thus, though all facts point most strongly to the conclusion that pyæmia is closely related to that form of putrefactive fermentation within the body which is combined with the development of minute forms of low organic life; yet, as the above cautions will show, we must not hastily conclude, that all and every part of the mystery is already solved by these recent discoveries, concerning the relationship between putrefaction and bacteria on the one hand, and the very frequent connection of these forms with septic disease on the other; that microzymes may exist in some fluids within the body, and yet pyæmia be absent, is certain, and it appears equally certain (Koch) that septic disease may destroy life, and yet no bacteria be detected.

After death from this very fatal disease the joints affected are generally found perfectly free from inflammation, if inflammation of a vascular part connote active hyperæmia and tissue-thickening. Sometimes pus is found in the cavity, sometimes merely the normal amount of healthy synovia. The pus, when present, is usually creamy, somewhat viscid, but smooth and homogeneous. It is sometimes rather dark, as though stained by mixture with a small quantity of some deeply colored material. Occasionally, it has some evil odor, hardly putrefactive, but allied to that state. I have occasionally found micrococci in this pus, but also have failed to do so. The leucocytes are frequently broken down, their contours are irregular, and the broken cells are crowded with quantities of microzymes and spores.

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[1] Report of Medical Officer to Privy Council, New Series, No. vi., p. 71.

[2] Die Micrococcen, etc., Langenbeck's Archiv, vol. xxii., p. 3.

[3] Dr. Heiberg (Die pyämische und puerperale Prozesse) says that "we must always consider these forms as coming from without." With this, as will have been seen, all facts do not agree.

When the joint contains merely the usual quantity of normal synovia, the peri-articular tissues are more involved than is the case when pus is in the joint. These tissues may, without hyperæmia, be bathed in a large quantity of serum or of pus ; tendinous sheaths in the neighborhood of affected joints are more especially liable to pus-deposits. I have often found these cavities filled with such fluid, while the joint itself has been free. Sometimes the peri-articular and tendinous tissues are hyperæmic, and there is something peculiar in the mode of injection of these parts ; the tint is not the ordinary bright red of inflammation, but is of a dusky, rather lurid color, and is especially remarkable in being patchy. In a small space of the section, big as a florin, one may find from two to seven or eight patches, from the size of a silver threepence to that of a split pea (the larger sizes are less common), marked by a deep purple coloration, the surrounding tissue being hardly deeper in tint than normal. In these patches the tissues are softened and friable. Such blot-like condition is also characteristic of any hyperæmia which may, as a rarity, affect the synovial membrane. Later on these patches become foci of suppuration, or rather, I would say, of " pus deposition."

That word leads naturally to a consideration of how pus comes into a joint-cavity, a tendinous sheath, or the meshes of areolar tissue, without producing or apparently being produced by any inflammatory act. The question admits of many answers, none of which are quite satisfactory, and certainly none are proven : perhaps with our present means of investigation no solution of the subject admits of direct proof. I think, at all events, the idea that pus is absorbed from one part of the body as an entity, and is deposited in that identity, in another cannot be sustained. It is this idea, however, which originated the term metastatic abscess, a term which had better be discontinued. Volkmann speaks of the pus-deposit as a purulent catarrh ; and in spite of his acknowledgment that the tissues are not inflamed, *i.e.*, are neither reddened nor swollen, says that the pus is formed *in loco*, as a catarrhal secretion.

My own strong conviction is that the pus-corpuscles found in pyæmic deposits are leucocytes, which, altered by the ingress into them of bacteroid germs,[1] have emigrated from the venous radicles, because that change has caused them to conglomerate within the vessels, to form minute thrombi or blocks, and to adhere to the vascular walls, producing stasis, which fails to be inflammatory, not only because the vessel and tissue changes of that process are absent ; but also because the blood-changes, however marked, are different in kind. The liquor puris is identical with blood-serum. The material, therefore, which is deposited from the vessels which we find in various cavities, and justly term pus, consists of septically altered leucocytes, suspended in a proportion of serum less than they floated in, while still circulating in the vessels. The attempt, therefore, so often made, to discover small quantities of pus in the blood is vain. Abstract the red disks, and the only difference between blood and non-inflammatory pus will be the larger ratio of the serum to the leucocytes.[1] In Case XVI., the blood, as seen in the transparent vessels of the meninges, was yellow, like thin pus ; a condition termed leucocytosis. Under the influence of any check to circulation, be it the impaction of a thrombus or zoöglœa, or some other mechanical obstruction, this deteriorated blood leaks from the vessels into the tissues or into cavities ; and as smaller channels are more likely to be thus blocked than larger ones, so are those parts, which possess minute tortuous

[1] The usual broken condition of the pus-corpuscle is to be remembered.

capillaries, most likely to be the seat of such outflow ; therefore organs like the lungs, liver, kidneys or joints are especially liable to suffer from pyæmic deposits. Now the blood, changed in the manner just described, comes out of the vessels in its entirety. Most of the few red disks also extravasate, and decaying rapidly, impart to the deposited liquid that brownish green hue characteristic of most pyæmic abscesses. In other words, the pus of secondary pyæmic deposits consists of the same liquid as that which circulates in the vessels, but inspissated, because the surrounding tissues rapidly reabsorb a large portion of the serum. The leucocyte infested with microzymes loses much of its amœboid nature, but it is not known that it also loses its power of emigration. To sum up, the pus, which is deposited in various parts of the body, is not a secretion, nor a mechanical transfer of fluid formed in one part to another part of the body ; it is simply produced by emigration of leucocytes, more or less broken down and otherwise changed during a non-inflammatory stasis ; but both the leucocytes and the accompanying serum are often modified by the direct influence of septic poison, *i.e.*, are themselves in a state of commencing or partial putrescence.

Hitherto I have only spoken of clinical septicæmia or pyæmia as consecutive to wounds, necrosis, and childbirth, the most common antecedents of the more rapid and violent forms of those manifestations. Of the existence of idiopathic pyæmia I am extremely sceptical, because there is considerable difference between a disease whose source we cannot discover and one which has no source at all. When we take into account the immense extent of skin and mucus, perhaps one should include serous surfaces, any little abrasion of which is quite capable of absorbing germ-charged fluids, when, also, we know that many of these surfaces are exposed to influences from without, we cannot but recognize great facilities for overlooking any small breach of surface. The intestinal tract, including all parts between the fauces and anus, are, especially at either extremity, very liable to cracks or ulcers. The vaginal and uterine membranes offer gates through which some form of blood-poison may only too readily pass ; and I err greatly if the urethra in the male do not open another door for such disease as is usually termed idiopathic.

Case XIV.—In the year 1868 I was called, in consultation with Sir Thomas Watson, to a gentleman about thirty years old, who, in the course of an acute lung malady, had become affected with swelling and pain of the right knee-joint. I recognized the enlargement and general condition as a very well-marked case of pyæmia, and have little doubt that the lung malady, if not of the same origin, was one involving secondary abscess, for that organ opened into the pleura, giving rise first to great pneumo-thorax, then to empyema. Subsequently other joints became affected, and a large abscess appeared below the middle of the thigh. The patient died, and no post-mortem examination was obtainable. I had carefully examined all accessible parts during life, and found no wound. The only perceptible source of infection was a miliary eruption, which had caused him to scratch a good deal. It was not until several years afterward that a friend of this gentleman confided to me that a little before his fatal illness he had contracted gonorrhœa of a virulent type—a fact which he was assiduous and successful in concealing, and at the time I saw him I could find no such discharge, which had doubtless ceased.

Case XV.—L. C., aged twenty-two, came to me in November, 1877, suffering from prostatitis, the result of a gonorrhœa. He was in considerable pain, had very frequent micturition, etc. He was getting rid of this

trouble when, having urgent business, he went to his chambers, where, owing to some blunder of the laundress, he was for some time in a fireless room. Next day he had a cold, toward evening felt very unwell, had a slight rigor, passed an almost sleepless night, and next day sent for me. I found him with hot, rather dry skin, white tongue, furred at the back, and other signs of pyrexia—thermometer 101.4°. He complained of severe aching at the loins, and of wandering pains about the joints, but more especially was the right shoulder very painful. I could find no swelling of this part. Of course the gravity of these symptoms was easily recognized. I prescribed a purge, and immediately on its action ten grains of quinine every six hours. Next morning he was rather better, and I ordered the quinine to be continued every four hours. In the course of the next afternoon he had two or three sharp rigors, and when I saw him two hours afterward, he had a temperature of 103.2°. The left knee was the joint chiefly affected, the left elbow was less swollen, and but slightly painful; there was no pain at the right shoulder. On the fourth and fifth day after the third rigor much the same as on third day. On sixth day left wrist swollen, with evident effusion into posterior tendinous sheaths; temperature in the morning, 102.8°; in the evening, 104.4°.

On eighth day.—Knee very painful and large, with palpable fluctuation; synovial membrane seemed dangerously distended; punctured the joint with piston-trocar and hydraulic tube, drawing off nearly five ounces of pus mixed with glomeruli. The right sterno-clavicular joint appeared also swollen, but there was no pain in it.

On tenth day.—The knee was but very slightly larger than after the puncture; the swelling over the right sterno-clavicular joint had assumed the appearance of a superficial abscess. The temperature had declined somewhat; it was 100.5° this morning, 102.3° this evening.

On twelfth day.—Opened antiseptically the abscess over inner side of sternum, which had become subcutaneous—temperature to-night, 101.2°. The knee not painful except on movement, and but very slightly swollen. After this the patient gradually mended, but the evening temperature remained over 100° for another fortnight. At the end of that time he drew my attention to an abscess on the right groin above Poupart's ligament. This was opened, and about three ounces of pus escaped; it was washed out with five per cent. solution of carbolic acid, and dressed with gauze.

After the discharge of this abscess the temperature declined to only a little above normal; the wound in the groin and at the clavicle healed. The knee-joint had nearly regained its natural size, but its movements were a good deal restricted.[1]

Case XVI.[2]—"A patient in the Bristol Infirmary for gonorrhœa and orchitis was attacked with great pain and swelling in the right knee. In a few days the lower part of the thigh was filled with matter which had escaped from the distended synovial membrane. The limb was subsequently amputated and the joint found to be completely disorganized."

Although I have still no post-mortem examination to prove a view which I first enunciated in 1860,[3] that the so-called gonorrhœal rheumatism is a mild form of pyæmia, I think the cases just quoted are sufficient to show

[1] The restoration of mobility to this joint is alluded to in another chapter.
[2] From the System of Surgery, vol. iv., p. 35.
[3] See first edition of this treatise, p. 79.

that gonorrhœa will occasionally produce pyæmia. We have already seen that blood-poisoning is not by any means uniformly intense (p. 63), that either a certain sluggish form of *contagium vivum*, dumb-bell, microzymes or a condition of fluids and tissues incapable of cultivating the more active forms, modify the disease down to a slight, comparatively harmless process; therefore the fact that gonorrhœal arthritis does not kill the sufferer does not by any means disprove its pyæmic origin.[1]

Indeed, as my study and experience of joint disease have gone on increasing, I have been forced to expand these views, and am able to state with complete conviction that other forms of synovitis—one connected with pregnancy independent of and previous to childbirth, one with disturbances of the menstrual function, and one with exanthematous and other fevers—have all a like origin; that is to say, from absorption into the blood of a deleterious material, which is in some of these diseases not pus, yet may be retained, and partially putrescent discharge, or the unhealthy excretions of a fœtus *in utero*. Thus we shall have to speak of various forms of these similar, but not identical affections, according as they are connected with the different systemic maladies or conditions above notified. With regard, however, to that malady, which has been most usually observed as a complication of gonorrhœa, it will be well to remember that its connection with that discharge is not constant, but that it has also been known to follow the use of catheters or bougies.[2] Hence, as its name, gonorrhœal rheumatism, is, in both adjective and noun, misleading, I propose henceforth to term it urethral synovitis.

As to the similar or even identical condition arising from disorders of female organs, it would be well also to have a distinct name, and I would propose metric or perimetric synovitis.

Symptoms.—Blood-poisoning by a septic influence derived from without exhibits in different persons various degrees of intensity. The most rapidly fatal form has received the name septicæmia, a less severe form is termed pyæmia; but it will have been gathered from the preceding section that there is no generic difference between the two diseases; the latter is probably only distinguished clinically from the former by a rather more protracted course, which gives time for the deposition of pus from the blood. The condition may be idiopathic (so called), that is to say may arise from no discoverable cause, such as wound, childbirth, etc., but far more frequently is in direct relation with some such condition. After a few hours of *malaise*, want of appetite, headache and perhaps wandering pains, rigors more or less severe are followed by a rapid rise of temperature, more rarely the pyrexia may supervene without any rigor. Such manifestations usually arise between the fourth and twelfth day after childbirth, but may occur at any time after receipt of a wound, for it is impossible to say when the poison may have been applied. When the disease arises from a visible wound, the skin around is, in the worst cases, of a dusky purple, roughened

[1] This was the chief objection urged against this theory of causation. The possibility of a surface-pus becoming putrid and absorbed by an unbroken mucous membrane must not be ignored.

[2] The clinical conditions of these cases lead one to suspect that one item may have been overlooked, namely, the possibility of some infective matter having been introduced on the instrument. I do not mean the pus of a gonorrhœa, but something in more or less a septic condition—be it a little putrescent mucus or blood adhering to the eye of the instrument, be it oil, into which many catheters and other things have been dipped. The urethra is often roughly treated by Holt's dilators and other things without producing joint-troubles, while these complications are said to follow occasionally very gentle manipulation.

by little nodules, tubers or pustules; beyond this deeply tinted part is a zone of less strongly marked color, varying often into brown, which gradually fades at the circumference into the normal hue; all this part, if it do not do so at once, soon pits on pressure, losing at the same time its color, which on removing the finger soon returns. If the surface be granulating these growths either suddenly disappear, put on a sloughy appearance, or may simply be dry, congested and lurid. The discharge changes its character from healthy pus to sanies, or ceases altogether. Lochia in puerperal cases become altered in color, scanty or altogether suppressed. The rise of temperature is in different cases of various character. The thermometer may, after the first rigor, bound with a sudden spring up to 102°—106°, and while observing a slight day-and-night fluctuation, never falls to near the normal. In other cases it may decline to 100°, or less, and then after another rigor rise again: this fluctuation I have known repeated very many times. Another mode of elevation is more gradual; the temperature may each night rise a degree, or a large fraction of a degree, higher than the night before, and sink in the morning nearly to the norm, so that the gradients become deeper and more violent for two or three days. After this, with or without the recurrence of a rigor, the thermometer keeps up to 104° or 104.5° evening, 101° or 102° morning. The skin is usually moist or rather clammy; there is a peculiar sickly sweet smell, both of the perspiration and breath; the tongue at first is white at the edges and tip, brown farther back and in the middle, then becomes thickly furred, and at last brown and dry. Breath is taken by suspiration rather than by respiration. Delirium of a low form, though occasionally violent, is a frequent symptom. The pulse at first is bounding and rapid; it soon loses the resilient quality, becoming small and too quick to count. The patient sinks rapidly, dying of asthenia. Certain symptoms, such as purging, occasionally with bloody stools, violent and persistent vomiting, hiccough, are frequent, but not constant. A very depressed and despondent mental condition is nearly always present.

In the worst form, just depicted, any joint-affection is not common; in the less violent malady, as when the temperature takes some days to rise, and rigors are recurrent with considerable regularity, when the condition of the wound alters but little or not at all, and when violent sweating now and then appears a critical symptom, pus becomes deposited in various parts of the body; such deposit being preceded by capillary engorgement, which gives rise to special symptoms, according to the organ attacked. Pyæmic icterus, dyspnœa, delirium, etc., are well known. Joint-affection manifests itself generally by severe pain and swelling. Very often in the less acute cases there will be for a time those flying uncertain pains which are so often termed rheumatic (malum rheumaticum vagum), then the disease localizes itself in one or more, commonly in several, joints, and frequently also in synovial sheaths, sometimes exclusively in these latter.

The local articular manifestation of blood-poisoning is very much the same, whatever be the particular material absorbed. I mean a severe case of joint disease, originating in pyæmia, will have the same local symptoms as an equally severe case following typhoid fever, gonorrhœa, scarlatina, etc. Mild cases also run in like grooves; nevertheless there are some exceptions in regard to certain poisonous influences, which will be noted in their place; the variations, too, as to severity, period of advent, relations to changes in the systemic affection, etc., produce a series of commutations in the clinical aspects of the disease, which I can scarcely hope to reproduce, and quite despair to exhaust. I can at all events attempt to give a general outline of this whole class of joint-affections.

The disease is nearly always multiple; the articulations most prone to poison influence are, in the following order, these: knee, elbow, wrist, ankle, shoulder, sterno-clavicular, hip;[1] but the smallest joints, as the temporo-maxillary, carpal, tarsal, and phalangeal, may participate in the disease.

When joint-affection has lasted from five to ten days in a multiple form, the malady usually recedes, if the systemic symptoms improve from all articulation except one, or at most two of those first on the list. The pain is slight while the part is at rest; and herein is a marked difference between this class of disease and rheumatism or gout; but the slightest movement produces intense suffering. Especially is that sort of pain we call tenderness a prominent symptom; it is not merely deep but superficial also—indeed, in some cases, the patient winces and whimpers at a rather slight touch, or at first contact, and shows less sign of pain on deeper and continued pressure.

As a rule, the swelling in all this order of disease is white. If redness be present at all, it will be of dusky quality, and in lines, racemose and in the axis of the limb, while the skin between them is markedly white. The swelling does not, as a rule, fluctuate evidently and plainly, like a suppurative or serous synovitis, although in certain cases of any form of virus-induced synovitis, the joint becomes largely distended. Œdema, more or less marked, occasionally coincides with the swelling, and then exceeds its limits; often indeed, especially if the disease be at the ankle or the knee, the parts below are very markedly œdematous and much swollen; in such cases large cutaneous veins meander over the tumid joint. If this œdema encroach upward, and be well developed for some distance above the articulation, suppuration, if the patient recover, will probably destroy the joint. The shape of the swelling, except in the rarer cases of intra-articular distention above alluded to, does not follow the shape of the synovial membrane, but is formless and round; sometimes distention of tendon-sheaths is evident to the eye, more often to the hand. There is very considerable tendency to metastasis from joint to joint in the earlier stages of the affection—early, that is, both of the general and local disease; many joints may be affected one after the other, and any one of them, either the first or the last attacked, or any intermediate one, may alone be the seat of any permanent or long-standing malady. Metastasis from a joint which has been seven days swollen is uncommon, although it may slowly recover. The knee, whatever other joints may have suffered, is most usually the seat of lingering disease.

Local heat cannot be verified; either there is no difference between the general and local temperature, or the latter is masked.

Urethral synovitis is generally the result of a gonorrhœa, not in the acute stage; but of a long-standing, obstinate, or neglected attack. It is an error which has been pretty nearly exploded, to imagine that joint-complications are produced by the rapid suppression of a gonorrhœa, for it is in long-standing cases that such troubles arise. It may also follow the use of catheters, etc. The malady usually commences with a rigor, always does so, indeed, when it results from catheterization; then comes pyrexia, with a temperature of 100°—102°, very rarely more; this is accompanied, or quickly succeeded, by rather severe pain in one or both knees, and generally in some other joint or joints. The knee very rarely escapes, I should have said never, but for a single case that came under my care. Not uncom-

[1] In typhoid synovitis the hip changes its place, coming first, even before the knee.

monly another complication is combined with the joint-affection, namely, conjunctivitis (not the violent inflammation from direct infection), more rarely iritis. The joints affected are white, and although in the commencement, and at the knee there is evident intra-articular effusion, this is less marked in other joints, and soon subsides, the chief enlargement being certainly peri-articular. The acute phase is not of long duration, but is succeeded by a subacute stage, during which the patient's health is greatly depressed; pain while at rest being slight, on movement pretty sharp; tenderness is very strongly marked. This phase is exceedingly obstinate, and, even when the patient has appeared well while in bed, he no sooner gets about than all the symptoms may return; this state of fluctuating recovery and relapse may continue for months. Even after what appears entire recovery, an exposure to cold or an error in diet, especially in drink, will bring on a recurrence. If the individual have been so unfortunate as to contract a fresh gonorrhœa he will hardly escape another attack of synovitis. I have known such recurrence occur after an interval of nine years, during which the patient had been married, had children born to him, been left a widower, and even what seemed most likely to change the habit of body, had spent nearly four years in the tropics. Singularly enough, too, it is by no means a necessity, though it may so occur, that the same joints which suffered in the old should be affected in the new attack.[1]

Metric Synovitis.—With the greatest desire to avoid unnecessary or pedantic refinements I must yet point out that there are in the cases of multiple synovitis arising in women and analogous in their symptoms and pathology with the urethral synovitis of males, certain clinical distinctions dividing them into three suborders, one occurring during pregnancy, one a month or six weeks after parturition, the third in non-pregnant women, virgin or otherwise, and connected with menstrual irregularity, generally with sudden suppression of the catamenial discharge. They all owe their origin to the absorption into the blood of deleterious materials.

The ante-partum synovitis of puerperal women begins between the fourth and seventh month of pregnancy, the post-partum from a month to six weeks after childbirth; occasionally there seems a continuity, interrupted by parturition, between the two attacks. The earlier one, with which we are now specially concerned, is most common (judging from the cases that I have seen) in women, who, previous to pregnancy, have suffered from considerable leucorrhœa, which on fecundation has been suppressed, or nearly so. The commencement of the disease is like the usual prodroma of a feverish attack. Rigors may be sometimes absent, but pyrexia is always present, with great *malaise* depression, and those vague pains in the back and limbs, which seem, even to the patient, like rheumatism. Soon these pains fix themselves in the joints, and for the first few days in several joints, leaving some and attacking others capriciously. Generally after or about the sixth day, the fever declines, the disease withdraws from all other articulations and attaches itself to one knee or hip—sometimes, but more rarely, two joints are affected; the above named, of opposite sides, seem to be more often companions in this attack than any other, but the knee and shoulder have simultaneously fallen under my care. If the disease become, after its first excursive character has passed away, mon-articular, the knee

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[1] Volkmann says, "I have treated two persons, who during a long series of years suffered, one seven times, the other four times, from gonorrhœa, each time complicated with poly-articular joint-inflammations which confined them to bed for months." —Pitha's and Billroth's Handbuch der Chirurgie, Bd. ii., p. 505.

is, I think, more often than any other the chosen joint,[1] but the hip alone is also a favorite place of attack. The joints affected are very painful on movement; only slightly so if at rest, but are very tender, even to light contact. The enlargement is not considerable, especially in joints which are soon deserted, but in those which have been affected from three to six days, the swelling is pretty severe. It is quite as much peri- as intra-articular; hence fluctuation, though it may be detected, does not so much fix attention as the doughy, shapeless, slightly pitting tumefaction I have so often described.

Women with this disease sometimes abort, or are prematurely confined; then the joint gets well slowly, use of the articulation being difficult to re-establish, not so much from stiffness as from weakness and looseness of parts, or if the disease have advanced further before abortion comes on, the joint will be anchylosed, even abscess may form, and a protracted suppuration, ending in destruction of the joint, will result. The worst form of case is a very serious, usually a fatal, disease. Such termination is to be dreaded, if after from four to six days the pyrexia, with which, as we have seen, the disease commences, do not decline, or if it do so, returns again with even higher temperature after one or two irregular rigors. In such a case the tongue becomes furred and brown, sweating is profuse, restlessness extreme, and pain in the affected joints severe; they too are more markedly swollen, fluctuate, are evidently suppurating. Abortion about the third day after the renewed pyrexia ushers in the last act of the tragedy.

In the mildest form of the disease, the temperature having declined, the joint, properly splinted and protected, remains swollen, getting sometimes a little better, but remaining tender until about ten days or a fortnight before the normal period of parturition, when the symptoms almost suddenly disappear; and if childbirth, and the after-effects be successfully passed through, may never return.[2] If the mother have a good supply of milk and suckle the child, she will probably escape a post-partum repetition of the disease. If she have little milk, or more surely, if a plentiful lactation be for any reason suppressed, the disease is almost certain to come back. I should say that in all these cases unusually careful irrigation with carbolic acid of the genital passages would be advisable after the birth of the child (p. 81).

A similar form of disease commencing between the second and fifth week after childbirth is rare, unless it have been preceded by the malady just described.[3] I have seen only four cases in an extensive and careful experience of more than thirty years, yet have some reason to believe that many more would be observed were they not as a rule ascribed to rheumatism, for the malady begins with pyrexia and vague pains followed by a multiple joint-affection, which has great proclivity to the shoulders, elbows, and wrist; yet after a time usually passes to the joints of the lower extremity. The commencement is by one or two indistinct rigors, then wandering pains in the shoulders and other joints of the upper limb, which swell somewhat, the enlargement being chiefly or entirely thecal. While at rest, the pain

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[1] A mere local result of pregnancy, described by Gmelin, Joyeux, and others, viz., softening and loosening of the pelvic symphyses is not to be confounded with this disease.

[2] Here we see are two forms alike in all points but this: in the former the fever declines and the woman retains the fœtus until the temperature is normal—she gets well. In the latter the pyrexia is continued, and abortion begins at a temperature of 102° or more. The infant may in either case be born living, but is more often dead.

[3] Of course I am not here speaking of puerperal pyæmia.

is merely a dull aching, but on movement is very sharp. It may be that the cause of this first predilection for the arm is the exertion of holding or lifting the baby. The pyrexia is not great, reaching rarely to 102°, and most commonly fluctuates between 99° and 101°. In only one of the cases that came under my notice did any permanent evil remain; this was a false anchylosis of the elbow-joint. The absorption or suppression of parturition-discharges appears to be the efficient cause of this disease, whose course resembles

Catamenial synovitis, a name whereby I designate joint-inflammations connected with certain accidental menstrual irregularities or interruptions produced by some external cause, such as fright, exposture to cold, etc. I have seen so many cases of this description that I can with certainty affirm the interrelation of cause and effect between the two phenomena. (See Cases XXV. and XXVI.) The peculiar synovitis generally attacks women of delicate constitution and lax fibre, subject to leucorrhœa, who have borne children, and above all have suffered from miscarriages, generally recent ones. If such persons having been exposed to cold, or having got wet during menstruation, especially at the commencement of that function, have the flow stopped suddenly, they are very likely to develop some form of inflammatory disease, erythema, erysipelas, or affections of internal organs, diarrhœa with gastric catarrh, etc. A certain number, instead of or with these maladies, develop a synovitis which is often sharp and severe. The disease is at first multiple, commencing with a smart attack of pyrexia, generally preceded by rigors; wandering pains, often ascribed to rheumatism, affect the joints, also the loins and hips; then these sensations localize themselves in one or two joints, and probably terminate by affecting one only, and that one nearly always the knee. The symptoms correspond very much with the general sketch above given of this kind of joint-disease, the swelling being, as a very general rule, chiefly peri-articular: in a few cases, however, intra-articular swelling is unusually strongly marked. Such are the cases which terminate in abscess of the joint; the more common tendency of the disease is toward false anchylosis.

Synovitis during typhoid fever is a sufficiently rare affection; yet in certain epidemics has been less uncommon than in others, a circumstance which we have no means of explaining. Thus Stromeyer [1] saw in a severe visitation at Munich three cases, while Güterbock [2] says that, in the four years, 1868–71 inclusive, the k.k. Krankenhaus at Vienna treated 3,130 cases of typhoid, among which only two joint-complications occurred. I have been permitted, through the kindness of my friend Dr. Broadbent, to test the records of the London Fever Hospital. It appears that in that institution no such complications have been recorded. But I can adduce a goodly array of such cases; for instance, Mr. Bellamy excised, in January, 1880, the hip of a boy aged eleven, who had suppuration of that joint occurring in the course of typhoid, and I shall shortly refer to some cases with which I was personally concerned. I have been fortunate in seeing, what must be considered, in so rare a malady, a large number of cases, and conclude from this experience that it includes two forms. The one which is confined, or almost confined, to the hip, commences at the end of the second or beginning of the third week—it is intra-articular, and produces rapid effusion and dislocation. This form is usually so painless, or the fever causes such an apathetic condition, that the patient is unaware of

[1] Stromeyer's Handbuch der Chirurgie.
[2] Langenbeck's Archiv, vol. xvi., p. 62.

any trouble at the part, and the disease is not infrequently recognized only when the patient is convalescent, and about to quit the bed, when luxation becomes evident. It is very rare that attempts at replacement succeed; but the limb very rapidly regains a considerable power of restricted movement.

The other form is multiple, begins toward the end of the second week, and occasions more suffering. Tenderness and pain on movement are especially strongly developed. The swelling is marked by considerable cutaneous redness, and puffiness, peri-articular abscess threatens constantly, yet may disappear, œdema of parts beneath the inflamed joint is common and strongly accentuated. The disease is always lingering. Albumen, generally a mere trace, sometimes in larger quantity, is commonly present in the urine.

This form is to be considered pyæmic, and resulting from the intestinal ulcerations,[1] giving rise to absorption into the blood of a *materies morbi*. It is very probable, though there is no proof of such fact, that one of the many forms of cocco-bacterium is in such cases the peccant matter. The disease, as affecting the synovial and peri-articular tissues simply, must be carefully distinguished from a form of osteomyelitis, which is also an occasional sequela of enteric fever, which attacks the limb-bones, and which, if it occur near a joint, will, of course, give rise to articular inflammation.

Exanthematous synovitis is not infrequent as a sequela of scarlatina, diphtheria, small-pox, measles, and even may follow chicken-pox. Mumps, as is well known, is much subject to metastasis; to the brain, to the testicle, and also, though less often, to the joints. It is said also that dysentery, at the time when recovery begins, is also thus accompanied; but scarlatina and measles are most prone to joint-complications. These affections have often, like gonorrhœal joint-maladies, been ascribed to rheumatism, even have been termed "consecutive rheumatism." But the only point in their course and condition which at all resembles the rheumatic, is that they are nearly always multiple; they possess neither the temperature of rheumatism, nor the slightest tendency to involve either the membranes of the heart or brain.[2] As a very general rule, the joints become affected singly, though rapidly, after one another, a knee, or perhaps both knees taking the precedence. The pain is in some of the cases rather severe, the temperature usually between 101° and 102°, more often at the lower than at the higher figure; the swelling is not considerable, and involves the peri-articular tissues more frequently than the synovial cavity itself, since through the reddened, perhaps even slightly œdematous, superficial textures no fluctuation, as in sero-synovitis, is perceptible; also it is to be observed that the superficial veins are not enlarged and strongly marked, as is always the case when œdema accompanies the more deeply seated inflammation.

This synovitis is generally a mild affection, coming on about the time when the skin or throat affection is declining, and usually gets well three or four days after the exanthem may be taken to have disappeared; in such cases the effusion is probably merely the puro-synovia already described (p. 26). In rarer cases the joint disease lasts longer, and this nearly always only at the knee, other articulations getting well. Such a

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[1] The first described mon-articular synovitis, confined almost entirely to the hip, can hardly be otherwise than a specific part of enteric fever.

[2] A metastasis of mumps to the cerebral meninges occasionally occurs without joint-affection.

joint goes through phases somewhat different to those of catamenial synovitis. These cases, too, vary somewhat among themselves, according to the age of the person attacked, and also according to the nature of the exanthem. The joint-affection following scarlatina tends more often to the suppurative form, and to produce, if the attack be at all severe, either disorganization or anchylosis very rapidly.[1] The synovitis which follows measles is, more than any other of these secondary inflammations, inclined to fall into a chronic phase after a subacute attack of a few days, and then to give rise to, or to become changed into, strumous synovitis. (See Chapter V.) This tendency of strumous inflammations to follow measles is not confined to joints, but may also be observed with regard to cervical lymphatic glands, palpebral conjunctiva, auditory meatus, etc. Thus if the histories of strumous inflammations be elicited with care and minuteness, one always finds a considerable proportion commencing after convalescence from measles. The scrofulous diathesis was, of course, present previous to the attack, and though we cannot trace what direct link there may be between measles and a more marked development of strumous cachexia, one cannot but observe that many scrofulous children are said to have been quite strong and well, previous to an attack of measles ; and that of those who suffer from struma after that exanthem, many have chronic joint disease.

The slighter forms of exanthematous joint diseases run a mild and rapid course ; the whole trouble having generally ended, leaving no reliquiæ in about a fortnight, and since the joint-affection arises toward the end of the exanthem, the recoveries from both maladies succeed each other thus : from the eruptive fever, three or four days before the joint-affections recede ; that is to say, the foci of infection being dried up, the infection ceases. The gravity of the poisoning is in proportion to the quantity of the poison. But sometimes an exanthematous synovitis is evidently pyæmic, and patients even die of such disease, consecutive to one of the skin-fevers ; and then the joint-affection, considered merely as a symptom, is barely mentioned. Such mortality only occurs when the pristine malady leaves behind it some suppurating focus, such as a pharyngeal ulcer from scarlatina, measles, or diphtheria, one or two obstinate sores after small-pox, a suppuration of the parotid after mumps, a meso-rectal or meso-colic abscess after dysentery, etc. Here the origin of infection continuing, the infection itself goes on.

Another, a mon-articular form, is likewise said to occur as a sequel to exanthemata or to dysentery. This, however, must be extremely rare for all such diseases. I have never seen a case of exanthematous synovitis commencing in a single joint.

Treatment.—The treatment of pyæmia hardly falls within the scope of a work on joint disease ; nevertheless, without some directions as to such management, this chapter would be so sadly incomplete, that it is impossible to refrain from saying something on the subject, and the less so because it appears to me that what I have to say will be of some service, and may be the means of saving here and there a life.

Pyæmia, even in its more severe forms, is not a malady so necessarily fatal that the person should be left to fate, or treated perfunctorily and hopelessly. On the contrary, when a patient, with a wound of any descrip-

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[1] While these sheets are going through the press I have been called to a sea-side town to see a young lady who some years ago had, during scarlatina, her right knee affected. The joint suppurated, some bone exfoliated, the result being true anchylosis in an awkward position.

tion, but *a fortiori* with one of a sort which we know might prove infective, has any symptom, such as a sudden rise of temperature, not otherwise to be accounted for ; more especially if the pyrexia have been preceded by a rigor or rigors, he should be instantly subjected to sharp and energetic treatment. The question of purgative must depend upon the condition of bowels. To purge for the mere sake of purging is not wise, since we do not want to promote absorption, but a clearance of loaded bowels is necessary. If mere aperient be necessary, a rather large enema, with a little turpentine in it, will save time ; if the liver appear torpid, colocynth and calomel may be given. The great object, however, is to administer a large dose of quinine as soon after the rigor as possible. I know with what scepticism the idea of quinine warding off pyæmia will by some be regarded ; also, I cannot but be aware that if such cases of sudden rigors and pyrexia consecutive to wound or compound fracture thus treated, do not eventuate in pyæmia, it may be said the patient would not have suffered much disease even without the quinine. But the sort of evidence is cumulative, and although septic disease is, I am happy to say, a great rarity in my hospital ; yet I have had such experience as to be able to say that in four cases marked by the symptoms above described, the disease was not developed. In a case of necrosis after fracture, the patient did have pyæmia, recovered after joint-affection ; in ten weeks had more rigors and pyrexia, when fresh treatment saved him from a second attack of the disease.[1] Local treatment should also be instantly employed for the purpose of disinfecting the wound and its neighborhood. Some of the experiments of Koch, Burdon-Sanderson, and others, show that the toxic effects of septics depend on a certain dose, and it would be against reason to suppose that this dose is taken into the system at one gulp as it were ; indeed, the clinical study of characteristic cases shows clearly that a certain *malaise* precedes the rigor, because the quantity requisite to produce this effect is not as yet taken up into the system, and that afterward elimination to a certain extent goes on ; but absorption also continues, hence the recurrent rigors, the irregular fits of pyrexia and the general variability of the condition. Indeed it is evident that the system has great power of excreting the pyæmic venom ; hence septic intoxication, *i.e.*, subjection of the vital powers by a single overwhelming dose of the poison is rare ; the usual course is by repeated acts of absorption with rigors, followed by pyrexia, which is interrupted by remissions, the result of elimination. Hence it may be doubted whether any case of pyæmia sufficiently recent to possess vitality fairly unimpaired would prove fatal, could we at once cut off all supply of fresh infective matter from the wound or other source of supply, and aid the system to rid itself of that already absorbed.

Hence, as soon as blood-poisoning manifests itself, the wound, if large enough to be so dealt with, should be opened up, filled, and mopped out with a solution (three or five per cent.) of carbolic acid. Even amputation, or other operation-wounds, however deep, should be thus dealt with. If the source of disease be a mere puncture, a probe should be passed along its track, and the opening enlarged until it can be thoroughly exposed to the action of the antiseptic lotion. Even further measures may be taken,

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[1] Dr. Sidney Ringer (Handbook of Therapeutics, p. 560, seventh ed.) doubts the value of quina in pyæmia, being, he says, "convinced that the falls in temperature were often normal." Perhaps this may have sometimes been the case, but I have watched the action of this drug on septic diseases too anxiously and carefully to have been deceived in the way indicated.

for if the wound be charged with bacteria, the neighborhood also will be more or less impregnated with them. Hence parenchymatous infiltration with the same acid may be advantageously employed. This is best effected by means of a tubular needle about two and a half or three inches long, perforated at the sides as well as at the end, and provided with a brass, or silver collar, to which one end of an india-rubber tube can be attached. A glass tube, about two feet long, and three-eighths of an inch diameter, drawn at one end to a blunt point, is filled, either by suction or simple immersion, with a three or four per cent. solution of carbolic acid, the india-rubber tube—which already has one end attached to the needle—is drawn over the conical end of the glass, and then the needle is passed deeply among the tissues in the immediate neighborhood, and above the infecting wound. Of course, during all this time, the operator will have kept his finger on the other end of the glass tube ; and this he now uncovers. The fluid soon begins to percolate the tissues more slowly, and therefore more widely and evenly than when a syringe is used, and the amount is very accurately measured by the gradual descent of the liquid in the tube. This descent may stop, and infiltration cease, while still insufficiently accomplished. Slight shifting or turning round of the needle will frequently renew the flow ; but, if this fail, one may apply the mouth to the end of the tube, and by blowing force a little more into the tissues ; afterward the flow generally continues of itself, or one may continue the insufflation. An ounce of a three per cent. solution may be injected without fear of producing carbolic acid poisoning and may be repeated daily, or if the pyæmia be strongly marked twice a day ; but during the process some of the urine should be preserved in an uncovered vessel ; when the secretion turns, after three or four hours' exposure to the air, of a blackish color, as though a few drops of ink were mixed with it, one must stop the procedure ; it is the first sign of carbolic poisoning. If this precaution be taken one need not fear evil results.

If the disease be post-partum pyæmia, the genital passages should be thoroughly and frequently washed out with carbolic acid. Mere syringing is of little use, or may be worse than useless—delusive. Irrigation with large quantities of a four per cent. solution is easily carried out by providing a metal bucket, at the bottom of which a tube projects ; to this an india-rubber pipe, terminating in a large vaginal canula, perforated at the end as well as at the sides, and provided with a stopcock, is attached. The bucket is hung high above the bed ; the patient lies on an india-rubber sheet, in whose folds an off-drain into a vessel on the floor can be arranged. The canula should be passed to the os uteri, and the stream allowed to flow for some time after that which comes away is perfectly clear and inoffensive ; then the instrument, the stream still flowing, should be so slowly withdrawn that no spot of the mucous membrane can escape.

After three, or at most four, large doses of quinine, whatever be the source of poisoning, have reduced, or failed to reduce [1] the temperature, the sulpho-carbolate of sodium should be given. A healthy person taking this combination, first introduced for other purposes by my friend Dr. Sansom, passes sulphides by the urine, while the breath is strongly impregnated with the odor of phenol ; hence it is evident that the blood takes up and

[1] I have very rarely indeed found quinine fail to bring down that sudden temperature which immediately follows a rigor, although the thermometer may, during administration, rise again ; but unless another rigor supervene, slowly and gradatim.

holds that substance in solution, and, in so far, the liquor sanguinis must be inimical to bacterial life.[1]

An occasional recurrence of rigors must not scare us from this treatment. (See Case XVIII.) It must be remembered that if any thrombi more or less charged with microzymes or putrescent be in the veins of the infection-focus, these matters must ultimately pass into the circulation, and that every fresh dose thus taken up, unless very small, manifests itself by one or more rigors, and a rise of temperature. If this elevation be transitory, and the mercury fall in from six to eight hours, the poison has been eliminated, or has been destroyed by the carbolic acid in the blood. We may, if the temperature be considerable after the rigor, exhibit two large doses of quinine, at an hour or two hours' interval, and then return to the sulpho-carbolate. Shorter phases of pyrexia, longer intervals of moderate temperature, mark progress in the right direction. Even some frequency of rigors, if only the thermometer elevation be of short duration indicates rapid absorption from the veins, not fresh poisoning by the wound itself or the effect of poison already absorbed. But since the presence of bacterial poison is eminently depressant on the vital powers we must keep them up by food and stimulants; frequently large doses of the latter are absolutely necessary, because assimilation is at a very low ebb.

The treatment of the joint-affection is in true pyæmia of secondary importance, nor during the brunt of the disease can we as a rule employ splints or other retentive apparatus, for the patient in that phase either lies perfectly still or is exceedingly restless. The swollen joints should be kept warm by wrapping them in wadding, if jactitation—and this sometimes occurs—come on, a light leather or poroplastic splint may be applied to the upper limb or ankle, while if the knee be affected the lower limb should be swung. If pus approach the surface, incisions may be made (antiseptically), but this is more often necessary in affections of the sheaths than of the joints themselves.

As a rule, if the patient recover the joints regain mobility, entirely if the swelling have been slight, with some stiffness if the enlargement have been considerable. A good deal of this stiffness depends on extra-articular causes, and may be overcome when the patient's health is sufficiently restored. (See Chapter XIX.) If the distention have been such as to necessitate free incision, false anchylosis usually results, though a case here and there may recover with very excellent mobility.

The treatment, both general and local, of puerperal pyæmia should be on the same lines. As consultant concerning the joint-affections I have seen a good many such cases, and have of late years earnestly pressed free irrigation of the genital passages with carbolic acid solution. A few cases saved (one is related in the sequel) are I believe almost entirely attributable to this practice. The irrigation should be carried out by means of a bucket hung sufficiently high to give through the india-rubber tube a stream of some power. Medical treatment and support must, of course, be employed, as in traumatic pyæmia.

Urethral synovitis is much more manageable if it arise from catheterism than if it originate in gonorrhœa. Such cases are rare; the discharge

[1] It would at first sight appear that salicine or its derivatives would have a like effect, since its passage through the kidneys demonstrates its solution in the blood. Thus guided I have tried the drug, but have found it quite without any power in the expected direction, and this in persons in whom the sulpho-carbolate medication was evidently beneficial.

which accompanies the attack, slight though it be, suggesting the possible action of infective influences (p. 74), would cause us to think of some disinfecting injection. The sulpho-carbolate of sodium or thymol might be used for this purpose without fear of irritating the urethra. Whenever rigors, as is not infrequent, occur after catheterism, the surgeon must bear in mind the possibility of joint-complications, the treatment of the former is the prophylactic (not perhaps always successful) of the latter, viz., either a massive dose or two of quinine, or what seems to answer equally well, a glass of very hot whiskey or brandy-and-water, and keeping the patient for three or four hours sweating under a thick pile of blankets, the sulpho-carbolate of sodium might then be prescribed. If in spite of this treatment joint-complications arise, they must be treated in the same way as gonorrhœal synovitis, but the case will be more manageable. An error now nearly discredited, whereby the joint-affections of gonorrhœa were attributed to rapid suppression of discharge, led to attempts at bringing back urethral suppuration—this, at all events, should never be done; on the contrary, the correct practice is to check what discharge may still remain. I need not here describe the treatment of obstinate gonorrhœa, but would nevertheless point to the advisability of using an aseptic injection, such as has just been mentioned. The joints must be placed at rest, and warmth, or even heat, will be found more valuable than cold. If the case be seen early, and be treated after the manner of pyæmia, with quinine and the sulpho-carbolate (p. 81), the attack may be cut short; if it be seen later, the treatment be directed against a supposed rheumatism, or if the malady, being temporized with, fall into a chronic state, the joint-affections are exceedingly obstinate; they certainly will not yield till some weeks after the last remnant of urethritis has disappeared. Under such circumstances I have found large doses of the perchloride of iron, several times daily, and the cubebs pepper, night and morning, the best remedy. If these fail, entire change, especially residence for a time at a ferruginous spring, usually succeeds.

The joints recover their mobility very slowly, and it is often difficult to estimate when passive movement may begin; this is to be judged by examining the points of tenderness (p. 31). Rubbing and shampooing may often be employed for some time before any motion is bearable. Frequent flying blisters, which during the acute phase of the attack are inadmissible, generally render considerable service in the lingering chronic stage, but vesication must be carefully avoided.

The different forms of metric synovitis are to be treated on a similar plan, nor do I think anything could be gained by going over the same ground with slight variations. The tendency of women suffering from ante-partum synovitis to abort must be considered, and means taken to avert this occurrence; or in some cases, if the general symptoms of blood-poisoning be strongly marked but without high pyrexia, abortion may be the only means of saving life, as permitting irrigation to reach the absorbent surface, and the passage outward of the peccant matter. Also I ought to point out that catamenial synovitis, occurring as it does in persons of irritable or nervous habit, is a very painful form of disease, which will require some little use of morphia.

The greater number of exanthematous synovial attacks are mild; rest and heat, with subsequent passive motion, will generally be all-sufficient to cure them. But the joint diseases which result from typhoid and scarlet fever are more severe. Both these affections being concomitants of dangerous degrees of fever, are often overlooked, or if observed, cannot be

treated in the then condition of the patient. Hence the malady is generally first discovered when it is too late, or nearly too late to save the joint. The articular affections which follow, or are concomitant with dysentery, are simply pyæmia, generally of rather a mild type so far as danger to life is concerned, but occasionally leading to destruction of the affected joint.

In conclusion, I must point to the following cases for proof of the above facts and views which are new to surgical science. Many more cases than are here detailed might have been quoted, could more space be assigned to this most interesting subject.

Case XVI.—Jane S. died of pyæmia in Charing Cross Hospital May 3, 1879. She came, under the care of Dr. Silver, with an abdominal tumor, February 17, 1879. The exact nature of the case was at first obscure, the general symptoms and temperature somewhat resembling enteric fever. The tumor was soon made out to be an abscess, probably, however, of the abdominal wall only. On March 20th this was opened ; it remained open and discharging for four weeks, and then closed. The discharge had no sooner ceased than pyæmic symptoms manifested themselves. The chief complaint of pain was in the left shoulder and a spot beneath the clavicle, just inside the coracoid process. Her death was from asthenia.

Post-mortem.—The abscess was, as diagnosed, external to the peritoneum but close to that membrane, an adhesion had taken place between its inner surface and the omentum, another with the liver ; but beyond this there were no signs of peritonitis. The muscles surrounding what had been an abscess were of a slaty green hue. One of the portal branches and the ramifications immediately next to it in the substance of the liver were filled with thick pus. This seemed corked down in the larger vein and in most of the twigs by coagulated but otherwise unaltered blood. The spleen was large, otherwise healthy, as were other abdominal organs. The thoracic viscera healthy, save that the pericardium contained a large quantity of fluid.

The brain was very pale, its upper surface appeared through the arachnoid of a dead or yellowish white. The vessels of the pia mater contained here and there inspissated red blood ; in other parts a thin yellowish fluid, which, on pressure, flowed backward and forward in the venous twig, and had all the appearances of thin pus. In the suter the subarachnoid fluid was cloudy and turbid ; when on puncturing the membrane this liquid escaped, it was found to be somewhat gelatiniform, and its turbidity was due (examined microscopically) to an admixture of leucocytes or pus-cells, many of which were broken and of irregular outline. The ventricles also contained a like fluid. The brain substance, even the gray matter, was very white. No puncta of divided vessels were seen. No abscess was found in any viscus ; no pus in the vena cava, portal, splenic vein, nor in the cerebral vessels.

Pus was found around the left shoulder-joint, immediately beneath a greatly thinned deltoid. This peri-articular pus communicated through two capsular openings with the shoulder-joint, one of which was on the outer side near the bicipital groove, the tendon from which had disappeared. The joint being opened, the synovial membrane was found of a very light pink, and so slightly roughened that this condition could only be seen when the membrane was held up so as to reflect the light. On the inner and posterior aspect of the capsule was another opening, which could be traced back to a large abscess-cavity, between the subscapular muscle and the venter of that bone.

The cartilage on the humerus had become exceedingly thin throughout,

but in only one part, about one inch long by one-third of an inch broad, had it quite disappeared. Over most of the surface it had become so thin that the bone looked at first sight bare, but a little examination showed that a film of cartilage was still attached. This extremely thinned part did not end abruptly in a thicker, but sloped gradually into a thicker spot—at the upper aspect of the globe. The cartilage remained quite smooth on the surface, was not fibrillated, nor had any punctured holes in it. It seemed, except that it was so extremely thin to the naked eye, normal; but under the microscope commencing granular degeneration, both of the cells and hyaline material, was evident.

Case XVII.—Maria G., aged eighteen, had compound fracture of the left clavicle thirteen days before admission. On November 2d she was admitted under Mr. Canton's care. The ends of the bone were protruding and necrosed; three days after admission she showed symptoms of pyæmia, of which she died November 30, 1876.

Autopsy, December 1st.—The right ankle had been painful and swollen for ten days; right wrist painful twenty-six hours; on left metacarpus was a circumscribed and fluctuating swelling. During the last sixty hours of life intellect had been very clouded, and it was difficult to make out any clearly painful spots, as she cried out wherever she was touched.

Left metacarpus.—The swelling was entirely superficial and contained only serum, slightly blood-stained, no micrococci.

Right wrist.—The veins were all full of blood, for the most part liquid; in one was a clot evidently post-mortem, and not broken down. The skin and subcutaneous tissue, on being cut, bled almost like that of a living person. The areolar tissue contained a little more fluid than usual. The sheaths of the extensor and of the flexor carpi ulnaris contained a little rather thick pus—this was not sufficient to distend them, it only oozed slowly from the incision, and did not appear to amount to more than from five to six minims in each. The synovial lining was unaltered, save, perhaps, a slightly roseate hue at one part.

Right ankle.—On both outer and inner side had been during life considerable swelling, but in the post-mortem room it was found that the thick cuticle on inner side of heel had broken (probably after death), and a good deal of serum had oozed from it; thus there was very little swelling on examination, but evidence of cellulitis on both sides of ankle and extending round the back. The front was quite healthy, the tendons normal. In the sheath of posterior tibial and flexor longus digitorum, as they passed over internal lateral ligament, a good deal, *i.e.*, about half a drachm, of very thick pus was found. The synovial sheaths were quite normal in color. The ankle-joint was perfectly normal, and the somewhat inspissated synovia, which lay at the back from gravitation, was clear and bright.

The pus in the tendinous sheaths contained a few ovoid and dumb-bell microzymes; no rod-shaped bacteria; the movements of the organisms were, if any, extremely sluggish. A number of minute highly refracting spots pervaded the field; they could only be seen as extremely small dots of light, and may or may not have been other micrococci in an early phase of development.

Case XVIII.—On June 15, 1879, I removed a small tumor from the inside of the thigh of Mr. P., aged twenty-seven. The wound healed, and he was apparently well on the 21st. On the 28th a corner of the scar reopened, and a little pus escaped. Of this he took no notice till December 1st, when, returning from the city, he had a sharp rigor, which was followed

at 9 P.M. by another; the wound became painful, he had no sleep, and felt very ill. I saw him on the 2d. His temperature was 103.4°, pulse 120, tongue rather dry and brown. I almost entirely opened the wound, and syringed with carbolic solution (1 in 20), and ordered a scruple of sulpho-carbolate of sodium every four hours. At night temperature 104.7°. Circumference of wound dusky. Passed in a tubular needle, and with india-rubber and glass-tube infiltrated the tissues with carbolic acid solution, 3 per cent. Dressed wound antiseptically.

December 3d.—Repeated the infiltration, and again at night; wound slightly suppurating. Temperature—morning 99.8°, evening 100°.

December 4th.—Infiltration at night only. Temperature normal.

December 9th.—No fresh symptoms; felt well. Temperature normal.

December 13th.—The wound healed again. He went out on the 12th, but felt a little weak; he now says he is as strong as ever.

It is, of course, impossible to say if this attack, left alone, would have developed into pyæmia; it had all the prodromata, and the dusky state of the wound led me to fear a very bad case. I determined to try the same medicine on a more decisive opportunity.

CASE XIX.—Marianne L., aged thirty-four, admitted into Golding Ward January 30, 1880.

She has had nine children; all have died early of some pulmonary disease. She herself has always been healthy. On January 9th suffered miscarriage of a five months' fœtus. Six weeks ago her leg began to swell after a few rigors; at first the swelling was not painful, but after a time pain at the back of the knee and in the groin commenced.

On admission.—The left leg was very much swollen, its surface shining, very white, and too tense to pit on pressure with the finger; very hot, and intensely painful; the left metacarpo-phalangeal joint was very painful—evidently the seat of secondary abscess; also threatened abscess of the right shoulder. Tongue moist, with lines of brown on each side of the raphe. No appetite. Temperature 104°; pulse over 130, small, very soft. She had a profuse blood-stained and highly offensive vaginal discharge. Ordered irrigation of the genital passages with solution of carbolic acid (1 in 40), and to take a scruple of the sulpho-carbolate of sodium, in camphor water, every four hours; brandy ten ounces.

A few days after admission the size of the limb was certainly less; it was measured thus:

Circumference of	ankle	12 inches.
"	midcalf	17 "
"	thigh	24 "

February 3d.—She had some diarrhœa—hence fifteen grains of salicylate of soda substituted for the sulpho-carbolate.

February 5th.—Vaginal discharge lessened, still considerable evil odor; the right shoulder and elbow swollen and painful; has some shiverings—hardly true rigors. Recur to the sulpho-carbolate. If any well-developed rigors occur she is to have ten grains of quinine at once, and five more in an hour unless the thermometer fall.

February 10th.—About midnight a sharp rigor. Temperature rose to 104.5°; came down to 103.2° at 4 A.M. Perspired profusely.

February 12th.—Better in every way; took food; pulse stronger; complexion clearer.

Circumference of ankle	11	inches.
" midcalf	16	"
" thigh	21½	"

February 18th.—Has had some rigors, and afterward high temperature, but only transient; the whole temperature line on a lower level. The thermometer was for two hours down to 99.2°. The pyæmic joints less swollen and painful.

Circumference of ankle	9¾	inches.
" midcalf	14¾	"
" thigh	18½	"

Discontinue irrigation.

February 21st.—Slowly improving; temperature line still irregular, but on generally lower level; variation from 99.8° to 103°.

February 24th:

Circumference of ankle	9½	inches.
" calf	13½	"
" thigh	15½	"

Right arm better; some pain and swelling in vaginal glands. Leave off the medicine.

March 4th.—Still getting better; left limb nearly normal in size; glands still painful but less swollen; left wrist and right arm greatly better.

March 16th.—Convalescent. Free movements in all affected joints; temperature normal; pulse firmer; appetite good.

March 24th.—Left for the sea-side.

Remarks.—The fœtus had probably died *in utero* and become putrid. The combination of white leg and pyæmia of the joints marked the case as very dangerous, because the internal and, to a very large extent, the common iliac vein must have been blocked with septic thrombi. A quantity of the poison must, therefore, of necessity be passed into the blood. The aim of treatment was threefold. To prevent fresh absorption of putrescent matters *e loco* (irrigation). To destroy or, at all events, prevent multiplication of bacteria in blood, by impregnating it with carbolic acid. To obviate the immediate effect of an ingress large enough to cause rigors and a high temperature, by one or two large doses of quinine given at the moment.

Case XX.—I was asked on December 17, 1879, by Mr. Ffrench Blake, of Victoria Square, Westminster, to see with him Mrs. B., and he gave me the following history.

She was thirty-five years old; had always been subject to leucorrhœa; had been married about a year, and on November 10th, was confined of twins, one full-grown, one still-born—so small and immature that its sex was undiscoverable. She went on well till November 24th, on which night rigors set in, and the next morning her temperature was 105°. She complained much of pain in the back, in the knees, in the left hip and shoulder. On the 26th her left, and on the 28th her right, leg became much swollen. On the 1st of December her left arm and elbow swelled, and the pain in the joint was very severe. The lochia continued, but was purulent or muco-purulent, with very offensive odor. Occasional rigors had occurred during this period. Lactation continued.

When I saw her on the 17th of December, I found both legs much swollen and œdematous; the joints of the lower limbs were not especially affected. The skin was white and glistening, a few surface-veins strongly marked. There was a swelling about the perineum threatening abscess. The left arm was swollen, and the elbow-joint, more especially large, was very painful; but, as far as could be made out in the general swelling, the enlargement was peri-articular. The tongue was brown and rather dry; the pulse 126, weak; skin hot and, where there was no swelling, dry, while over the swollen parts it was sticky and clammy; temperature, 103.8°. Constipation; inertia; great thirst; sleeplessness. An aperient was ordered, and half a grain of morphia at night. As soon as the bowels had acted, ten grains of quinine at a dose, and five grains to be given every four hours. Eight ounces of brandy; meat essences and strong soups. Also irrigation by a long tube, per vaginam, of a three per cent. solution of carbolic acid.

December 21st.—She was considerably better; the swelling of the limbs had, however, not much decreased; the elbow-joint was much less swollen, and the perineal swelling had subsided. Brandy had been changed to champagne; she took her food fairly well; pulse 98; temperature, 100.1°; tongue cleaner.

December 25th.—Very much improved; the swelling of the limbs beginning to decline. Tongue nearly clean; temperature, 99.6°; vaginal discharge had nearly ceased.

Mr. Blake managed the rest of the case, and reported to me that her progress was uninterrupted; that about January 4th her evening temperature was 99°, morning normal. On the 25th, swelling of the limbs, save slight œdema about the ankles, had disappeared; on the 28th she got up, but was still kept in the same room; by February 1st he ceased attendance, and she was about the house.

Remarks.—In this case the conditions giving rise to pyæmia are less distinctive than in Case XIX. Mr. Blake was inclined to consider the second immature fœtus as an instance of superfœtation; but perhaps the original fecundation was double, the one fœtus dying early *in utero* and becoming there putrescent.

At various times Dr. Blackmore, of Hammersmith, has asked me to see the following cases, and has kindly furnished me with abstracts. My own observations at the time of seeing the cases are inserted.

Case XXI.—January 31, 1879.—Dr. Blackmore was called to see Mrs. M., aged twenty-six years, married; has two children, of which the youngest is aged eighteen months; was about five months pregnant. Husband suffering from gonorrhœa of some weeks' duration. Patient complained of slight pain on micturition, a white discharge, and was generally unwell.

January 25th.—Complained of pain in both shoulders and the left elbow; felt very unwell; had some slight shiverings.

February 1st.—The pain had ceased in the joints above named, but the right ankle had become very painful, swollen, and tender to touch.

March 15th.—I saw Mrs. M. with Dr. Blackmore, found the ankle swollen, white, and tender, could not bear the slightest movement; the swelling was chiefly peri-articular, but there was some fluid, probably surface pus (p. 29), in the joint. She had lost flesh; had some pyrexia; about 100° at 4 P.M.

April 19th.—Premature labor (just over the seventh month). Very small female child, which two days after birth suffered from severe puru-

lent ophthalmia; it died on April 25th. After childbirth the mother's ankle got rapidly well—only slight stiffness left, which passive movement soon cured.

Case XXII.—Dr. Blackmore saw, July 13, 1879, Mrs. A.; married; one child. At the time she was not quite four months pregnant. She complained of vague but rather severe pains in all the large joints; those of the left side were more especially affected. In about a week they all got well, except the left elbow, which yielded to rest on a splint and other remedies in about sixteen days.

August 11th.—Again sent for on account of a similar affection of the left knee, which was much swollen, painful, and tender. In spite of careful treatment the disease of the knee continued until October 25th, when she was allowed to get up.

December 5th.—She was confined at the beginning of the eighth month of a small female child, which a few days after birth was affected with severe purulent ophthalmia.

Case XXIII.—August 30, 1879.—Dr. Blackmore saw Mrs. C., aged twenty-eight; she has four children, the youngest being three years old; was not quite four months pregnant. Two days previously felt very unwell, had some shivering, and then pain in left shoulder and right wrist. In three days the shoulder was well, but the wrist remained swollen and exceedingly tender, she could not bear it touched. This continued for three months, the part then was placed in a plaster-of-Paris bandage, when it became less painful, but remained œdematous.

January 4th.—Was delivered of a small female child (beginning of eighth month), which a few days after birth had very severe purulent ophthalmia of one eye. The bandage, which had been taken off, was replaced; the hand in the interval was quite useless.

February 20th.—I saw her with Dr. Blackmore. The synovial membrane of the wrist was lax from former distention, but the chief force of the disease had been in the tendinous extensor sheaths. Under narcosis the adhesions were broken down.

February 26th.—The movement of the fingers much less painful, but still the hand, excessively weak, had to be kept on a splint, as the muscles could not support its weight. She very slowly improved.

Case XXIV.—Dr. Leonard Sedgwick, of Gloucester Place, asked me, August 13, 1877, to see with him in consultation Mrs. A., aged forty-eight years, with an affection of the left knee-joint. The following history was given me at the time. She had several children, was of lax fibre, suffered from considerable leucorrhœa, and rather free menstruation at each period. At the latter part of May she was caught in a sharp shower while at a distance from home; no cab was to be obtained, she got wet through, and had in that state to walk home. The catamenia stopped suddenly. Four days afterward she had two sharp rigors, followed by considerable pyrexia, pain in the shoulders, back and hips; afterward both knees became painful. Gradually all the joints recovered, except the left knee, which remained swollen and very painful. Subcutaneous injections of morphia were necessary to procure sleep. The pyrexia, more especially at night, continued. Temperature: morning, 99°, and evening, 102.1°.

The knee at the above date was swollen, the enlargement being chiefly peri-articular—it was white, the limb-segment below pitted slightly on prolonged pressure, the joint was extremely tender, and rather too much flexed. In face of the very tender condition, we agreed to apply only a poroplastic splint, at present in the same position, to give full doses of quinine, to try

gradually to decrease the morphia, and to take the first favorable opportunity of administering an anæsthetic, and placing the limb in better posture.

August 29th.—Patient was in every way better; the nightly temperature had declined, and the tenderness greatly decreased. Ether was administered, the knee placed in nearly a straight position, and plaster-of-Paris bandage applied. Some grating, not of bone, was felt. An unfavorable prognosis as to the subsequent mobility of the knee-joint was given.

From this time the patient went on fairly well, nor did I see her again for about five months, during which time another surgeon had endeavored to restore mobility, but without success, some painful symptoms returning.

March 25, 1878.—An anæsthetic was administered, and I bent the knee to a right angle; and afterward both Dr. Sedgwick and I endeavored to induce her to undergo passive movement, even with the help of an anæsthetic; but she was very sensitive to pain, disliked repetition of the ether, and seemed rather more inclined to be content with what had been gained than to undergo further troubles and discomforts. The gain, so far as movement is concerned, was not much; nor, unless the patient be very persevering, can such joints be restored. She enjoys a certain, though small, flexibility of the limb; and can walk, though a little stiffly, with barely a limp.

Case XXV.—J. S., aged nineteen years, was admitted into Charing Cross Hospital, under the care of Dr. Pollock, supposed to be suffering from polyarticular rheumatism, February, 1880. Some of the symptoms not being consistent with this diagnosis, he asked me to see her February 22d. The disease had commenced in both the shoulders and the left elbow; pain in the back, too, was very severe. When I saw her, the right hip was alone affected; it was painless, or nearly so when left at rest; but she complained of the slightest motion. The limb was apparently lengthened; the innominate followed every movement of the thigh. There was considerable tenderness, not merely of the joint, but of the more superficial parts, so that pinching a thick fold of the integument produced complaint. There was some diffused swelling behind the trochanter and in the groin. The case was evidently not rheumatism, but resembled some one of the absorptive joint diseases. It was elicited that during the last menstrual period—twelve days before her admission—she had caught a severe cold, the catamenia stopped suddenly, and a leucorrhœa, to which she had been subject, had also almost disappeared. At my suggestion she was treated with large doses of quinine, and extension by weight. The pain gradually declined, and she made a very slow recovery by false anchylosis, whose treatment is mentioned elsewhere.

Case XXVI.—Marianne W. came under my care into Charing Cross Hospital, January 2, 1880, suffering from disease of the right knee. The malady had commenced a fortnight previously, with pain and swelling of the right shoulder and both elbows, preceded by a slight rigor. After three days the pain declined in the upper extremities, and both knees became affected; after a few days more the left knee got well, but the right one worse and more definitely swollen.

On examination the enlargement was found to be chiefly peri-articular, the surface-tenderness was considerable; the joint was rather white in color. This history and condition indicated one of the absorption diseases, and on questioning her I learned that she was in the fifth month of pregnancy, and that previous to impregnation she had long suffered from leucorrhœa. The knee was placed in cotton wool on a MacIntyre splint, and swung on a Salter's cradle; the joint hardly improved, but was perhaps a little less swollen.

February 22d.—She was prematurely confined (beginning of seventh month); after this the knee rapidly got better, and in five weeks was quite well.

Case XXVII.—Mrs. L., aged twenty-five years, consulted me concerning pain and weakness of a knee and of both wrists, March 15, 1877. She was pale, slim, of lax fibre, had been married three and a half years. Two years previously she miscarried between the fifth and sixth month. Since that time a leucorrhœa, from which she always had, more or less, suffered, became profuse until about six months previous to the above date, when she again became *enceinte*, and the discharge greatly decreased. On the 3d of the month she felt very unwell, was feverish, had slight shivering and severe pain in the back. She kept very still lest miscarriage should again come on. She appeared to get better, but on the 8th the same symptoms recurred: she had great pain in the shoulders, elbows, and hips, and could hardly move; one or more of her joints were swollen—the disease was considered to be acute rheumatism; in four days more all the joints were free except the left knee and both wrists.

The knee was swollen, the enlargement entirely peri-articular, the skin white, tenderness to touch considerable. The wrists were very sensitive, the pain being at the back; the joint itself was evidently unaffected, but the extensor sheaths were distended, movement was very painful, even to support the hand straight with the arm caused her considerable suffering. Tongue rather white at the sides, brownish at the back and in the middle. Temperature, 103.6°. Pulse 125, small and weak. The conditions of the case did not appear to me to agree with the symptoms of rheumatic fever; more especially the odor of the skin and of the breath, not acid, but as of mouldy hay, as well as the early remission and recurrence, appeared to point to one of the absorption diseases. I treated her on this view with rather large doses of quinine, varied as the temperature rose and fell. Irrigation being, under the circumstances, inadmissible, I ordered merely injection with carbolic acid, and wrapped the joints in cotton-wool, supporting the hand on light mill-board splints. Good diet and some stimulus.

March 31st.—Certainly better. The tongue was cleaner, temperature rarely rising above 100°, but all the affected joints were still very weak, somewhat swollen, only painful on movement. Flying blisters (not vesication) to the wrists alternately.

April 13th.—Blisters having been used alternately to the knee and wrists, they became less painful, and at above date could be moved a little. Ten grains of sulpho-carbolate of sodium every four hours. This being the first case in which the drug had, so far as I know, been used internally as an aseptic, I was, in the then condition of the patient, very cautious.

April 28th.—The patient improved considerably; after three days the dose of the drug was increased to fifteen grains; on the 24th she was allowed to get up, and at date could, while supported by her husband, walk without pain.

July 26th.—Mr. L. came, requesting me to return with him. He informed me that on June 6th his wife had been confined, child healthy, and all went well. She had nursed the infant for six weeks, but then the supply became less, and the baby occasionally sick after taking the breast; she left off suckling by rapid degrees, but without pain or trouble. Three days ago she had headache and was sick, took some purgative, seemed a little better, but on the evening previous to sending had been shivering and ailing; during the night very hot and restless.

I found her complaining of headache and general *malaise*, more espe-

cially of pain in the hips and lower part of the back; she had a great sense of disquiet and oppression, said she never felt so ill before, and was sure she should die. Her skin was very hot, but not particularly dry; she had not menstruated since her confinement. The breasts were rather full; a little milk oozed on pressure. Attributing her condition to a too sudden cessation of lactation, I inserted liq. atropine with a fine camel-hair brush into any milk which I could see, gave a smart purge and some effervescent ammonia. She was rather better up to

August 2d.—A smart rigor ushered in a return of pyrexia. When I saw her the temperature was 104.4° She had intense pain in the right knee and both hips. I treated her with large doses of quinine.

August 11th.—The right knee and hips were no longer painful, but for five days the temperature continued very high, from 100° to 102.5°. On the 15th the left knee became swollen and tender; it was at this time the only joint affected, and shortly was exceedingly painful—much swollen—and was put in a plaster-of-Paris splint. The sulpho-carbolate of sodium was substituted for quinine.

August 26th.—Somewhat profuse menstruation began.

August 9th.—The menstruation continued nine days, during which time she got better; the temperature declined.

The patient recovered slowly, the knee remaining some time stiff, and was twice flexed and moved under the influence of ether, and though quite able to move it in all desirable directions, she never recovered the full power of flexion enjoyed by the other, nor could she place it quite straight.

Case XXVIII.—Dr. Churchill, of Chesham, sent to me, April 4, 1874, Mrs. L., aged thirty-nine, married, always enjoying good health until shortly after the Christmas preceding, when she was severely attacked by enteric fever. She had been almost completely unconscious for five days. When getting convalescent it was observed that the left limb was considerably shortened, and Dr. Churchill, when she was able to undergo examination, diagnosed dislocation of the hip. It was impossible to trace this occurrence to any particular time or epoch of the illness. As soon as she was able to travel she was brought to town, and I was able to confirm Dr. Churchill's diagnosis. It was impossible to replace the head of the bone in the acetabulum; but the movements of Bigelow's method gave her a far freer mobility, and although she could, when leaving, walk very much better than those who have suffered unreduced traumatic luxation, there is no doubt but that considerable lameness must remain through life.

Case XXIX.—In the latter end of October, 1879, Mr. Wilcox, of Aylesbury, sent me a young lady, aged sixteen, on account of hip-lameness. On February 7, 1879, she had been, in common with other members of her family, attacked with typhoid fever. Her illness was very severe; she lay perfectly insensible for six weeks, swallowing and performing the other functions of life unconsciously. She was, however, kept alive by assiduous nursing, yet in spite of the utmost care the skin over the sacrum sloughed. About the time when prospects of saving life became a little better, Mr. Wilcox observed that the right lower limb looked short, but the patient was far too ill either to be thoroughly examined or subjected to treatment for the joint-affection. When at last, thirty-four weeks after the commencement of her illness, she could be moved, Mr. Wilcox sent her to me.

An examination showed the femur to be dislocated upon the *dorsum ilii;* the limb was nearly three inches short, the foot inverted, and the trochanter lay high above Nélaton's line. In correspondence with Mr.

Wilcox, who had come to the same conclusion, it was agreed that we should endeavor to replace the bone ; accordingly,

October 22d, chloroform having been administered, we first endeavored, by manipulation, to reduce the dislocation. Numerous adhesions gave way with audible rending, but the head of the femur would not enter the acetabulum. The pulleys were then applied, with equal unsuccess. I believe the head of the bone lay on the cavity, but probably this latter had contracted during the interval. The patient, who had been lying upon a mattress on the floor, was put to bed, and weights were applied. Later in the evening $\frac{1}{3}$ grain of morphia was given ; this soporific, of which she had already taken, during her illness, a number of doses, was occasionally administered during the rest of the case.

She stayed in town a fortnight, during which time extension was used with the hope of procuring greater length of limb. Passive movement was from time to time attempted, but the patient was feeble, very sensitive, and but little in this way could be effected. On November 8th she returned home but little benefited.

Mr. Wilcox writes that "Mary W. did not leave her bed until sixteen weeks after the commencement of her illness. It was when she attempted to stand that I first noticed the shortness of her leg. While she remained in bed nothing led me to believe that there was anything wrong about her hip, although the prolonged high temperature caused me to examine her more than once for some reason for it. The conclusion I came to was that the temperature was high in consequence of extensive bed-sores."

Her left leg is now thirty-one inches in length, from ant. sup. spine of the ilium to point of external malleolus ; right, thirty-three inches. The foot is slightly inverted, with very diminished power of eversion. She walks short distances without crutch or stick. Power of walking increases slowly. She gains steadily in weight and strength.

CHAPTER V.

STRUMOUS SYNOVITIS.

Pathology.—We began our account of synovial disease with the examination of an acute simple affection, and it was pointed out that, as the inflammation subsides, it merges into a less and less severe condition, which, if the constitution be healthy, passes more or less rapidly away. But if any morbid diathesis be present, it is apt to influence and prolong the inflammatory acts, to impress upon them its own peculiarity and type. Thus, a local manifestation of constitutional vice may be traced back to some injury, bringing on an acute attack, which up to a certain point was easily subdued, but beyond that point was exceedingly obstinate. Other chronic maladies have no such definite origin, but begin, if in our patient's remembrance, with some intangible history, or, as he may say, "of itself." The diathesis which most frequently gives rise, thus out of the vague, to chronic joint disease, is struma; the same cachexia possesses only a slighter pre-eminence in adding a chronic continuation to an acute inflammation.

Some objection has been of late years taken to the name "strumous" as applied to the very chronic joint-maladies about to be considered. Mr. Holmes[1] in particular would deny, or at least "question," the propriety of this very convenient and common appellation: apparently for two reasons, that, when the affected part is removed, the disease does not constantly, nor indeed often, recur; and that tuberculosis does not always, nor very frequently, arise in children thus affected. I cannot but think that two errors of ratiocination underlie this argument: firstly, the idea that tuberculosis is a necessary sequel and accompaniment of scrofula; secondly, a want of definition as to what we mean by scrofula or struma. If, for instance, we accept Billroth's version, a disposition to chronic inflammation of the membranes, bones and joints, in which the inflammatory process may lead to the development of granulation, suppuration, or caseous degeneration,"[2] I do not see how we can exclude the fungating synovitis from strumous disease. Or the same pathologist's description in another place: "We assume a scrofulous diathesis for those cases in which a slight and transient irritation of some part of the body sets up a chronic inflammatory process, which not only outlasts the irritation, but spreads or continues independently of it, which usually results in suppuration or caseation, and rarely assumes the form of a pure hyperplasia."[3] With this latter description I thoroughly agree, and therefore must accept the very occurrence of this particular form of inflammation as symptomatic of struma; nor is Mr. Holmes's objection comprehensible, unless to it were appended what his peculiar (for to me it seems peculiar) definition of scrophulosis or struma may be. Moreover, the

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[1] Surgical Treatment of Children's Diseases, p. 424.

[2] Billroth's Surgery, Sydenham Society Ed., vol. ii., p. 107.

[3] Billroth's Scrophulosis and Tuberculosis: Pitha's and Billroth's Handbuch der Chirurgie, Bd. i., Abth. 2, Heft 1, p. 311.

minute morbid anatomy of the diseased tissue being the same, whether one or many joints be affected, excludes the idea of marking a difference in their appellation. The fact that tubercles have been found in the inflammatory tissue, that many children subjects of this joint-affection die of pulmonary or meningitic tuberculosis, more than justifies me in continuing the term strumous synovitis for this particular class of joint disease, although quite aware of the fact that such synovitis may be occasionally the only visible morbid result of the diathesis.

Case XXX.—Charles ——, aged ten, was admitted under my care into Charing Cross Hospital, April 25, 1872, with disease of the knee-joint. He was a small child, very thin, and had evidently been insufficiently fed; the right knee bore all the marks of strumous synovitis. He had been only twenty-three days in hospital when cerebral symptoms supervened, and he died shortly after of tubercular meningitis. I examined the joint very carefully, making first a cut across the lower part of the thigh, from each end of which an incision extended to the tibial tuberosity, about half an inch from the side of the patella. The flap had to be dissected off very thin, because close under the skin in some places, in others a little deeper, the knife discovered a translucent, gelatinous substance of a light yellow hue, which took the place of the peri-articular and synovial tissues, obliterated or filled up the subcrureal sac, and greatly encroached on or filled the cavity of the joint. Some white lines, as of fibre-tissue, permeated this gelatinous mass, and a few small, tortuous vessels were seen running, and owing to its translucency could be followed a little way into its thickness, where some of them split up into a lash of long, winding twigs.

The external ligaments, including the lateral, were found not so much sunk in, as merged into and continuous with this tissue. They were, more especially on their deep surface, commingled with the morbid tissue, which could neither be dissected from them with the blade, nor pushed off them with the handle of the scalpel without breaking at innumerable points.

This tissue being incised in the same direction and to the same extent as the skin, was turned back so as to expose what little remained of the joint-cavity (the subcrureal sac was entirely filled up), which contained a thin pus mixed with many larger and smaller flocculi. This fluid showed a strong tendency to separate into a turbid liquor puris and a thicker, more opaque sediment. The walls of the cavity were uneven and nodular, rather more pink than the other parts of the tissue; they encroached on the cartilages, so that on the patella only an irregular oval, about the size of a sixpence, remained uncovered; on the inner condyle of the femur a similar surface, oval with the long axis across (from side to side); on the outer condyle a very small part was bare. No cartilage on the tibial parts was exposed in this position of the joint, namely, considerably flexed. The portions of tissue intruding on the joint-surfaces were rather thin, in places so much so that the sheen of the hidden cartilages could be seen through them; they were digitated or serrated, and in the prolongation long, wavy vessels showed as tortuous lines. By opening the cavity farther and more completely flexing the joint, these dendriform growths were drawn away from the cartilages, to which they in spots adhered, and were seen to consist of vascular tufts surrounded by gelatiniform tissue.

The same was observed on the patellar surface. Around the patella, whence this outgrowth chiefly sprang, as at the sides of the inner joint-surface, the tissue was rather redder than elsewhere. The menisci had disappeared; they had simply become part of the gelatinous mass. The cru-

cial ligaments had all but vanished; a few scattered white fibres lying in the pinkish growth was all that remained of them.

The points where the morbid fringes that encroached on the cartilage had adhered were easily found, since in drawing those growths away a little tuft of the pink tissue was left behind; these were seen to have intruded into little roughened holes that were partly filled by these tufts, partly by fibrous débris of the cartilage, and the two structures had contracted close union. In one spot on the inner condyle, which was not covered by any synovial outgrowth, was a shallow, irregular ulcer, the edges of which were sharp and well defined, while its base was yellowish, dull and pulpy.

The microscope showed the bulk of this yellow or pink tissue to consist of innumerable round cells and bare nuclei, with here and there a tract of fibre-cells running through it, sometimes surrounding long, small arteries; also among them were fibres of evidently older growth, which I took to be partly destroyed lymphatics.

The microscopic characters of the cartilage will be described in a chapter devoted to changes in that structure.

Examination of disease somewhat further advanced may also be described.

Case XXXI.—Phœbe H——, aged nine, was admitted, under Mr. Hancock's care, into the Charing Cross Hospital, April 22, 1856, with a far advanced strumous disease of the knee. Owing to the state of the patient's health, the limb was amputated on May 3d.

May 3d.—I examined the limb. On dissecting up the patella and opening the joint no cavity could be seen, except two small spaces, whose position and size will be described immediately. The whole space between the skin and these cavities appeared converted into a light brown jelly, intersected here and there by thin, white, fibrous, glistening bands, marked by small wavy vessels, and spotted by specks of extravasated blood, of a hue somewhat darker than that of the veins. The interarticular cartilages could not be found; the external ligaments of the joint were only visible as scattered white fibrillæ separated from each other by the gelatinous tissue; the crucial ligaments were in a similar condition. On each side of these latter structures, and of the mass of jelly which enclosed them, was a pyriform cavity; the larger part, which would admit the finger, being situated in front, some distance from the patella, the smaller end running backward and a little outward; they were in shape like the lateral ventricles of the brain without the descending cornua; they contained pus, and the smaller end communicated with abscesses, under the corresponding heads of the gastrocnemius muscle. There appeared to be no communication between the cavities, nor between the abscesses. The gelatinous matter was in places immediately under the skin, and was generally about two inches thick; not so much at the back, more at the side of the patella. There was no trace of articular cartilage on any of the joint-surfaces; but the jelly-like material appeared to rise equally from the synovial membrane and from the otherwise bare cancelli of the femur, tibia, and patella. A section across the ligamentum patellæ presented the cut ends of the fibres separated from each other by the same gelatinous tissue; they seemed swollen and sodden. Examined by the microscope, this substance was found to consist of a number of nucleated cells—round, oval and fusiform, of bare nuclei, and of granules. Most of the fusiform cells were arranged in lines,

three or four cells broad; the cells lying end to end, or, rather, with their thin ends just overlapping the similar extremities of their neighbors to the right and left. These lines of cells crossed and recrossed each other, forming irregular spaces, in which the round cells and other constituents of the tissue were stored. The white bands presented simply a fibrous appearance, and were much tougher than any other part of the tissue.

These examinations may well be taken as our starting-point in the description of the disease. I need only premise that they depict cases of very decided type, strumous synovitis, *κατ' ἐξοχήν*, of which we see, both in hospital and in private practice, an immense quantity. It is the malady whose description by Wiseman gave the name, while morbid anatomy was in its infancy, of "white swelling"—*tumor albus*—to almost every chronic joint disease. It is also the malady described by Sir Benjamin Brodie as a "morbid change of the synovial membrane," and is named Fungöse Gelenkentzündung by Billroth[1] and Volkmann,[2] tumeur fongueuse, by Velpeau,[3] Bonnet,[4] Richet,[5] and others.

The appearances above described, which distinguish this disease from other chronic maladies of joints, consist in the large development of a semi-solid or gelatinous material, which slowly permeates, invades, and indeed, in its fullest development, substitutes itself for every articulation tissue. This growth, as I pointed out in 1859,[6] is simply granulation, and since then the word and the view have been adopted by pathologists, English and continental. All inflammations of connective tissue are constituted, or at least accompanied, by more or less plentiful germination of cells, chiefly, probably, of tissue-cells.[7] This cell-proliferation was first signalized by Virchow in his "Cellular Pathology." It is not absolutely the first act of acute, but is certainly the most important part of chronic inflammations. In a simple chronic inflammation the affected tissue becomes hardened and enlarged by the accumulation of cells, to over-repletion, in what were previously spaces of the tissue, while the histological elements themselves become altered by the metamorphosis of their constituent cells into mere proliferation-tissue cells. In a certain time, if the action subside, the older parts resume their former state, the fresh growths consolidate, form new fibrous tissue, and the part gets well, leaving behind it only a certain amount of thickening, which may itself in due course disappear. Inflammation, modified by struma, goes through precisely the same processes of cell-germination and growth, but there it stops for an indefinite time. The new material does not harden into tissue, nor indeed does it for a long period take on any fresh act except increase; it simply remains an abortive or embryo tissue. The condition, save that it occurs beneath the skin, is precisely the same as that of an indolent ulcer, which neither heals nor enlarges, but simply granulates. In strumous synovitis the cell-growth or granulation arises both from the free surface of the synovial membrane, and from the attached, or rather from the fine subsynovial tissue. The former of these commences by a slight increase in size of the fringes, so that the inner surface of the membrane is visibly roughened,

[1] Chirurgische Pathologie.
[2] Krankheiten des Bewegungsapparat.
[3] Dictionnaire en xxx vols.
[4] Maladies des articulations.
[5] Sur les tumeurs blanches. Hüter calls different degrees of this disease synovitis hyperplastica granulosa (s. fungosa) and synovitis hyperplastica tuberosa (s. papillaris).
[6] See Beale's Archives, vol. ii., No. 5.
[7] See p. 27 for the reasons of my belief concerning the small part which errant white corpuscles play in inflammation of synovial and areolar tissues.

like the mucous coat of the intestine, or a granular conjunctiva. After a time a still further increase takes place, but the villi do not assume the dendritic or arborescent form of growth so marked in other disease. In the less severe cases they throw out digitations, or membraniform expansions, which creep over the cartilages with after-results to be soon described. In the more characteristic strumous forms several fringe-processes uniting, form thicker nodular projections of conical shape, with apices intruding into the cavity, and bases forming part of the general thickening. The difference is one of degree merely, not to my mind requiring distinctions in nomenclature. The secretion from a membrane so altered is not, of course, normal; its variations will be described immediately.

In the Museum of the Charing Cross Hospital are many excellent specimens of this sort of growth. It must, however, be remembered that the fine translucent appearance is entirely lost by preservation in spirit, and a mere nodular yellowish vegetation, incrusting the cartilages more or less, remains. Also in the College of Surgeons' Museum are some excellent preparations.

The growth from the peri-synovial tissue increases outward, and gradually involves all the articular circumference; the synovial basement-membrane, caught as it were between these two, is merged into and disappears in the growth. The two parts, that from within and that from without—the *intima*—then form but one mass, traversed by the ligaments of the joint. These themselves do not, however, remain healthy: the common areolar tissue which permeates them, binding together their fibres, carrying the capillaries and lymphatic rootlets, germinates, and forms granulations in their very substance, separates or loosens their fibres, starving the fibrillæ, which fall into fatty degeneration, and are at last absorbed, so that the bones, forming the joint, become movable in directions not intended by nature, and may even be partially or totally dislocated by muscular contractions. All this, and I feel that I can hardly too often repeat the fact, is not in itself different to the first acts of a common inflammation; only its amount and persistence are different; for whereas in a healthy act parts would cease to germinate, and would either solidify or degenerate, this form of inflammation only continues the vegetative act, resulting in transformation of all soft parts around the bones into a jelly-like, pink, translucent mass.[1]

Under a good power of microscope this tissue is seen to consist in its more recent parts almost entirely of round and oval cells, also of bare nuclei; it is precisely the same as granulation from a wound or ulcer. The older portions contain also a number of fusiform, even of fibre-cells, which arrange themselves, overlapping their thin extremities, into lines that intersect each other, and divide the more embryonic tissue into spaces or loculi. This is a commencement toward the formation of areolar tissue; the lines of fusiform cells are more or less abundant and clearly marked, more or less scanty and imperfect, according to the more or less completely unhealthy nature of the case. In the former condition a tolerably distinct attempt to form areolar tissue is made; the cells in question are long in proportion to their breadth, even become mere cell-fibres, more opaque

[1] Koster (Virchow's Archiv, Bd. xlviii.) has described in this tissue the presence of small miliary tubercles. I differ from that authority with great caution and reluctance, but am bound to say that I have never been able to convince myself that the little specks were other than various forms of degeneration, fatty and suppurative, occurring in the substance of the new-growth.

and whiter than the rounder examples. In the latter the cells are not far from the oval shape, and the attempt to form fibre is but very slightly evidenced. Between these two conditions many intermediate gradations exist.

This whole process of cell-formation described above, at perhaps too great a length, is called "tissue-vegetation" (*Gewebsvegetation*) by Rokitansky, who gives the subjoined account of the process:

"A second portion of the products of the inflamed tissues (*serous membranes*), the 'Gewebsvegetation' (*tissue-vegetation*), must be distinguished from exudation, and arises in consequence of effusion into the subserous tissue. It consists in a growth from the basement-membrane of masses of cells, in a vegetation of round, oval, and fusiform cells which dissolve themselves into a hyaline mass and become areolar fibrillæ. Examination of this material on serous membranes offers the most and richest explanations on the origin and development of this vegetation. On the serous membranes arise layers of round, oval, and fusiform cells of $\frac{1}{50}$ millimetre in diameter, with nuclei of $\frac{1}{100}$ millimetre. They grow out of the membrane in the form of a delicate villous covering, papilla-like granulations, or of branching and anastomosing folds, and give to the surface its well-known dull, velvety appearance. At the same time the serous membrane loses its fibrous texture, and assumes a hyaline, gelatinous consistence. The vegetation forms itself into a simple or an interrupted lamella, or into a network, and these again give origin to new masses of cells, of fringes, papillæ, or bands. In this way are piled up simple or looped lamellæ or network; these last intermingle freely, whereby a change into fibrous connective tissue advances from the older to the newer strata. The nutriment for this continuous vegetation is derived chiefly from the vessels advancing into it from the serous membrane; but some portion of it may be borrowed from the exudation contained in the cavity within the growing formation. The growth, when the blastema (histogenetic material) dissolves, is reduced into a serous fluid."—"Lehrbuch der pathologischen Anatomie," Band i., S. 136.

Thus far the morbid actions consist entirely in the heaping up of new elements; they may be called the generative or vegetative processes, and constitute that portion of the disease, which in the first edition of this work was called the first stage, a division which has been adopted by Volkmann and others. Before passing on to the other stages, it will be well to examine the result of these actions, namely, more or less complete metamorphosis of synovial and peri-articular tissues into gelatinous granulation material. The very reduced cavity is filled with a pus, which is generally not quite laudable, having abnormal tendency to separate into liquor puris, floating cells, and flocculi. The adventitious tissue attains in different specimens to various degrees of thickness, previous to the commencement of any second phase, *i.e.*, of any affection of cartilage or bone, of any external or interstitial abscess. I have often examined joints of children in which this embryonic tissue, in places from one inch and a half to two inches thick, occupied the whole space between the central cavity and the skin; in which the cartilage remained entire, and only somewhat dulled on the surface. In this tissue in certain cases there would be an abscess communicating or not with the joint-cavity; in others no interstitial suppuration had taken place. I have also examined joints affected with the same disease, in which changes in the cartilage and in the new tissue, one or both, had occurred; that is to say, the second and third stage of the disease had commenced before the adventitious material had attained any

very considerable thickness, and before it had so entirely invaded and replaced the normal tissues of the part.

These variations depend in part upon the sort of joint; at an articulation, such as the knee, shoulder, or even elbow, the large bones offer longer resistance to invasion, than do the small bones of the carpus or anterior part of the tarsus, whose nutrition is much affected by false growths around them, and whose proportion to the bulk of synovial tissue is so much less. Also in part upon the age of the patient, or, in other words, upon the condition of the epiphysal end of the bone. If the nucleus be still small, and a considerable thickness of cartilage (it can hardly be called articular) subtend the joint, changes of that material are postponed till a later date in the history of the disease.

Second Stage.—At an uncertain period of the vegetative action in the synovial membrane the cartilages become diseased. The changes taking place in cartilage will be fully discussed in a future chapter, but it will be necessary to say a few words on the subject here. Many years ago, in scattered papers,[1] as well as in the first edition of this work, I pointed out that ulceration in cartilage, occurring during the course of inflammatory joint disease, is itself the result of inflammation in that tissue, not, as was previously believed, of an eroding action by the false membranes developed from the synovial membrane. This view is now so generally held, that it is not advisable to go through the system of proof, which then was necessary.

The ulceration of cartilage may occur in two forms, one very rapid, and another much slower. The two are not unfrequently present in different points of the same cartilage, or in different cartilages of the same joint, and the appearances vary considerably in each form. In the slower process the first appearance is a slightly elevated spot, where the structure has lost its polish and its translucency, assuming also a light yellowish tinge. A section perpendicularly through one of these spots shows it to be conical in shape, its base at the free surface, its apex deep in the cartilaginous structure, and more or less close to, touching or truncated by the bone, according to the age of the ulcer.

If the section be examined by the microscope, it will be seen that, at the diseased part, the cartilage-corpuscles have become much larger, and the cells contained in them have also greatly increased both in size and number, each one being provided with a number of nuclei, and having become more or less granular; some of them also contain oil-globules.

This disturbance of the usual condition is in its earliest stage below the part which looks to the naked eye diseased; but becomes more and more marked toward the free edge of the section, where many of the swollen corpuscles lose their distinctness of outline, and even coalesce. The indistinctness of outline is owing, according to Rokitansky and Weber, to the gelatification of the hyaline substance, but this assertion requires proof; it is certain, however, that during and in consequence of this alteration in the cells, the hyaline substance becomes obscurely granular, striated, and fibrous; it also frequently assumes a yellowish color.

The free surface of these unhealthy spots, examined by the microscope, presents a rough uneven aspect, full of irregular depressions and equally irregular elevations. The depressions are formed by the rupture of swollen corpuscles, and the elevations, which are fibrous or velvety, by the projection of the altered hyaline substance. Scattered over this surface are many

[1] On the Articular Cartilages, British and Foreign Quarterly, October, 1859. Ulceration of Cartilages, Edinburgh Monthly Journal, February, 1860.

cells, with several nuclei, and more or less granular, some of which are undergoing further changes, becoming fusiform or even stellate.

These spots may occur in any part of the cartilage, either at the edge overlapped by the false tissue or in the middle of the joint, where two surfaces of cartilage are in actual contact, no false tissue intervening, or in any part of the encrusting material which granulation has not yet reached; again, under this tissue the cartilage may remain for the most part healthy, and in these places the whole zone of false tissue, with its ramifications and its plexus of vessels, can be lifted entirely from the cartilage, wherever that structure has remained sound; but, wherever it has undergone the alterations already described, there occurs a peculiar adhesion between the two tissues in a manner now to be explained. As the ulceration continues it approaches more and more the attached surface, the hyaline substance becomes fibrous over a greater area and in greater depth, the corpuscles increase in size and burst, discharging the cells into the surrounding struc-

FIG. 7.—Section of strumous ulcer of cartilage magnified 500 diams.

FIG. 8.—Section of cartilage becoming slowly transformed into areolar tissue.

ture, in which many apparently empty rifts and chasms are perceptible. The direction of these cracks appears peculiarly arbitrary; some of them run with the fibres, others directly, others obliquely, across them; many of them terminate at either end more or less abruptly; but some of them, and this of course depends upon a fortunate position of the section, are seen to diverge from a centre larger than any one of the branches, which are themselves larger near the centre than toward their termination; the whole shape is like that of a crack or star in a pane of glass, produced by striking it with any small object. On examining this stellate rift more closely, it will be seen to be granular throughout; on applying dilute acetic acid the granules fade, and in the centre of the star one or more nuclei will become evident. This apparently empty space is therefore not empty at all, nor is it a series of cracks in the hyaline substance, whose directions are accidental. It is a stellate cell developed from one of the cartilage-cells, that had been scattered from a ruptured corpuscle, and which is in form and size exactly like one of the cells so characteristic of areolar tissue. In

fact, the cartilage has slowly undergone a transformation into a form of nascent areolar tissue, and at the same time there has occurred, between the structure thus formed and the similar material growing from the synovial membrane, an adhesion or interweaving which becomes more and more intimate until at last it is mere continuity. It is this condition which led Mr. Aston Key[1] to ascribe the ulceration of cartilage to the action of a rodent tissue growing from the inner surface of the synovial membrane, which gradually absorbed the cartilage, supposed in this instance to be perfectly passive. A clearer knowledge, however, and a closer study of the phenomena lead us to the truth, that the cartilage is ulcerated by an action or actions of its own, and thus we come back as nearly as possible to Sir B. Brodie's opinion. This celebrated surgeon so clearly saw that this was the case, that in order to explain its possibility he had to insist on the presence of vessels, because non-vascular parts were, in his time, supposed incapable of inflammation. As, however, it can now be certainly affirmed that any part which is capable of nutrition is also liable to inflammation, it can, I submit, be no longer denied that cartilage is liable to be inflamed, and consequently ulcerated, whenever an inflammatory disease attacks the other structures of the joint.[2]

It has been said that during this process many cartilage-corpuscles burst on or near the surface, discharging the cells among the fibres of the altered hyaline substance, and into the joint-cavity. We have in the present chapter traced what becomes of them in the former situation. As to what happens to them in the latter nothing certain can be known; it is probable that the greater number fall into fatty degeneration and dissolve away. Others no doubt contribute their quota to the pus in the cavity.

In a quicker form of ulceration (see Chapter XIII.), loss of substance is so rapid, that a previous stage is barely discoverable; the hole in the structure is under such circumstances bounded by clean-cut edges, as though a piece had been cut out with a knife or punch. Sometimes these edges are remarkably regular, more often peculiarly irregular. As a rule, in this form of ulceration the articular lamella disappears with or immediately after the cartilage.

Such rapid ulceration nearly always occurs at those parts of the cartilages which are in contact with each other, for, as already said, and again to be mentioned, the mutual pressure of the joint-bones is greater in disease than in health. Especially liable to this ulceration are the cartilages of joints which have been allowed to remain in some malposture, either because the pressure is thereby increased, or because the point of pressure is an unaccustomed and abnormal one. We may often find in such places that the cartilages have entirely succumbed to rapid ulceration, while elsewhere they will be either non-eroded, or only beginning slowly to give way.

The overaction of the cartilage-cells must call for additional nutriment; in other words, for additional blood-supply. The hyperæmia, the visible sign of this increased nutrition, is found in the vessels of the cancelli, which immediately underlie the articular lamella. I have already shown that the acute ulceration of cartilage brings with it a redness and fulness of this part, easily seen on sawing through the bone longitudinally. It should,

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[1] Med. Chir. Trans., vol. xix.

[2] See my papers On the Articular Cartilages, in the British and Foreign Quarterly, October, 1859, and in the Edinburgh Monthly Journal, February 1860, since which, and since the appearance of the first edition of this work, the views of scientific surgeons on this subject have become consonant with those then enunciated.

when possible, be checked by examining the fellow-bone of the opposite side, but it is generally well enough marked to be unmistakable. This hyperæmia, especially as pressure between the bones continues, readily turns to inflammation at that spot, and this is one of the routes whereby synovitis spreads to the cancellous bone-tissue. The ostitis is followed by formation of granulations, and these occurring in the same person and constitution as the synovitis, have the same tendency to remain embryonic rather than to proceed onward to tissue-formation. The cancellous cavities become filled with gelatiniform tissue exactly similar to that of the synovial membranes; the cancellar plates also inflame, soften, and are many of them absorbed into a like tissue or become carious; the articular lamella is detached. If this detachment takes place at a spot to which cartilage is still connected, that portion falls into the cavity, or lies loose among the granulations. We often find among the altered tissues, such pieces lying adrift; on their deep surface a sabulous roughness, the remains of the lamella, which came away with the cartilage, is to be felt. But the cancellar cavities may be laid open in another way, by the formation of small holes underlying little cartilaginous ulcers, and the granulations may sprout through them, and, invading more and more substance of the bone and cartilage, increase in size until two or more of these holes run together, when a larger breach of surface will ensue. In either way the cancellous cavities are laid open to the joint, or rather to the tissue which has taken its place, and the granulations from the bone mingle with those of the soft parts.

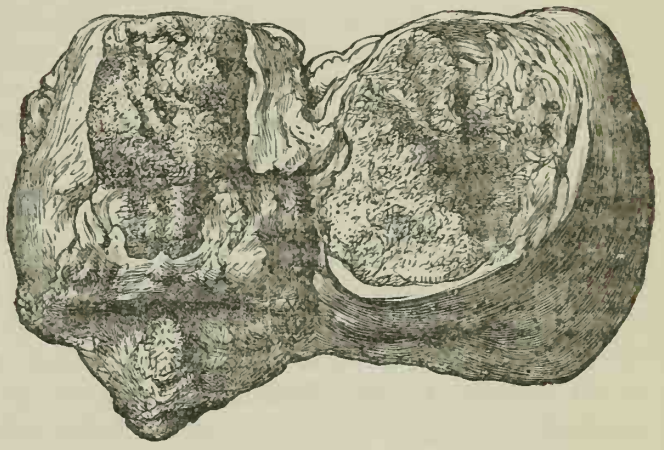

FIG. 9.—Upper surface of tibia. Ulceration of cartilages.

The result in either case is the same, namely, two (in certain joints three) bones with unsealed ends are united more or less loosely together by a soft granulation-tissue, which occupies all the space from the subcutaneous tissue inward, and passing into the unclosed bone-ends fills also the cancellous cavities. In advanced cases all else has disappeared: there are two tubular bones, conjoined by a quantity of embryonic tissue enclosing a central cavity, surrounded by skin and a certain thickness of subcutaneous tissue.

Even the cortex of these bones, often very much thinned, shows signs of very similar change; for a certain distance from their ends their tissue will be rarefied, the vascular foramina will be greatly increased in size, making in or on the surface furrows and gaps, which are filled with the same gelatinous tissue, while even the structure which separates these breaches will be softened—osteoporosis and osteomalacia. Beyond this distance, whatever it may be, the osseous surface is usually roughened by a few small osteophytes. These appearances are the result of another road by which the inflammation invades the bone, namely, by the periosteum. The furrowed or worm-eaten and softened bone marks the limit of the more complete inflammatory act; beyond that the presence of osteophytes show where less inflammation permits formative actions.

Third Stage.—The third stage consists in one of two processes, the consolidation into, and tissue-formation of, the granulation mass; the degeneration and destruction of that material, together with the parts it encloses and involves. Neither of these processes takes place alone, without, that is to say, some admixture of the other; nevertheless one, whichever it may be, is predominant, and, if it continue, brings the whole joint either to repair or destruction.

Reparative Processes.—These consist of actions in all respects similar to cicatrization. At any stage of the malady the proliferation may stop, the inflammation subside; there then results a short period of entire inaction, and after that the granulation mass initiates a metamorphosis into more or less perfect fibrous tissue, or more exactly cicatricial tissue. The final result depends upon the phase to which the disease had reached before the commencement of this curative act; if only to the first stage, and the cartilages be still entire, or to the second, and the cancellous bone-cavities be laid open.

The process itself is the fibrillation and contraction of the embryonic tissue. It commences over a large part, and sends processes or tentacles of fibre-tissue farther and farther away, and these form fresh centres from which organizing processes start; a highly irregular network, with elongated mesh, is thus spread through the gelatinous mass, each space enclosing some of the jelly, which generally rapidly follows the course of the rest; but sometimes remains obstinate; or may fall into fatty degeneration, liquefy, and become absorbed, or again may dissolve into pus, forming a localized abscess even in the midst of the consolidating tissue.

As a rule, when the consolidating process has once begun over a certain portion of, it spreads through the whole morbid growth, and converts it into coarse inflexible fibre-tissue, which uniting the bones, and in its cicatricial contraction binding them closely together, forms, if the process stop here, false or fibrous anchylosis; the amount of mobility at the joint depending upon the quantity of fresh granulation-tissue which had been formed prior to the setting in of the healing process; to the amount of change in the shape of the bone-ends, and to the amount of cicatricial contraction which takes place during healing. This contraction, if considerable, brings the bones closer and closer together, and at last may bind them so tightly, that even if the tissue remain fibrous, but little movement is permitted between the bone-ends, probably more or less altered in shape. Also more especially if the granulation-tissue have lain very close to the skin, that structure will by the same process be drawn inward toward the centre, so that after consolidation is complete, the joint will be found smaller than its fellow, the skin being tightly stretched over it. If the mouth of an old abscess or sinus have existed, this will also be dragged inward, and when healed it will present a considerable depression, with hard bottom and edges.

If the action do not stop at simple fibrillation, the next step is ossification of the structure. This commences always in those layers which lie in close contact with the bone, and chiefly those next the edges of the exposed, and up to the present time softened, cancellar walls. These walls harden again by the deposition of new lime-salts in the pre-existing but altered bone; this deposition does not stop at the old limits, but gradually invades the fibres sprouting from those walls in stellate and arborescent forms, until the outgrowth from the two bones uniting together prevents all movement, and still continuing, causes complete bony union of the joint by a reticular osseous cancellar-like structure. These processes are termed respectively cure by false and by true anchylosis.

But there is another set of actions which nearly always occurs, sometimes to the entire exclusion of any reinstating processes, more often mingled with such process over smaller or larger spaces, namely degenerative or disintegrating actions. It is evident that such granulation tissue as is above described cannot, however persistent, be permanent; it must eventually either move toward tissue-formation, or toward disintegration; that which does not become fibre of some sort becomes fatty, puriform or both. In almost every case of strumous synovitis, which advances to the stage of cartilage or bone ulceration, or indeed to considerable growth of cellular elements, these changes manifest themselves on the surface of the newly formed granulations which surround the original cavity, and also in various spots in the thickness of the tissue itself. Thus results from the former puriform secretion and fatty *débris* within the cavity; from the latter, localized abscesses in the new parts surrounding that cavity. In examining anatomically a joint, the seat of strumous disease for many months, the nearly obliterated and irregular cavity is found filled with a flocculent, often thin pus, mingled with oil-globules, which has been secreted by the granulations, or results from their deliquescence. Such abscesses may judiciously be termed intra-articular; they often lie open to the outer air, generally by somewhat narrow but not very tortuous channels; frequently also they communicate with one or more of the next sort of abscess.

Suppuration also frequently occurs in the substance of the new granulation-tissue; it is preceded by fatty degeneration at the spot which gives to the part a pale, almost greenish, and then when pus begins to form, an opalescent or milky look. These "peri-articular abscesses" may, after a time, communicate with the fluid in the joint-cavity, they may pass outward or travel in both directions; not unfrequently, instead of perforating the skin at once, the pus spreads out between that structure and the granulation, causing a wide separation between them; and when at last the skin gives way, it does so over a wide surface, much of it perishes, and there results a rather large ulcer, with blue inverted undermined edges, and with foul indolent floor.

Another class of abscess, that among the muscles in the neighborhood of the joint, "adjacent abscess," is far less usual in synovial than in osseous joint disease; more particularly the deeper variety which steals along the periosteum is rare in this malady, as also is an elongated abscess running up or down in the substance of the bone itself. We shall encounter them in another chapter.

These more distant abscesses are preceded by formation of fungoid granulations, and result from defective plasticity, and subsequent degeneration of that tissue, not from any exuberant vitality of the part. It is, of course, to be understood, that neither the curative, formative acts above described, nor the degenerative processes just mentioned, occur simultaneously over the whole diseased area, or are always continuous and regular. On the contrary, joints that are becoming anchylosed may, in spots among the fibrillating tissue, develop abscess, or the intra-articular abscess may tend outward, propelled more hastily by the contractile force of the fibrillating tissue itself, and by the pressure thus exerted on the fluid. Thus even during the progress of cure by anchylosis, abscess, formed at the time or long ago, may point at the skin. Sometimes, on the contrary, the fluid parts of the pus become absorbed, leaving somewhere among the meshes of an anchylosed joint a dried up mortar-like material, which may lie quiescent, indefinitely, perhaps altogether, but which, if any fresh source of irritation, such as a blow or strain, be superadded, may after many years

again liquefy and threaten, or actually develop into abscess. Or again, strumous joints which are manifestly in the degenerative and suppurating phase will maintain for a time, here and there, a local and restricted tendency to fibrillation. Yet it is to be remarked that, although sometimes between these powers a sort of strife for the upper hand may take place, the one or the other ultimately predominates, and that, even at the point to which we have traced this suppurative form of the third stage, recovery, of course with a stiffened joint, is still possible.

If, on the contrary, degenerative actions become predominant, certain remarkable events usually occur ; they result from destruction, more or less complete, of the ligaments, by the decay of the granulations, which, as we have seen (p. 95), permeate their fibres. The joint may even in the first stage have become somewhat loosened, but in this third phase, when the ligamentous fibres share the fate of the degenerating cell-tissue, the bones are so loosely held that the one may be moved in several abnormal directions upon the other. Subluxations, in some joints complete dislocations, may then take place, generally in the direction of the flexors,[1] because it is those muscles which are predominant ; but occasionally in other directions, as, for instance, at the knee, though rarely, the tibia may be dislocated outward, by overaction of the popliteus. Even now, it is to be remarked, healing *may* occur ; and indeed the luxation itself, the cessation of pressure by one joint surface on another, is of itself a cause of amelioration. After such event the starting-pains almost invariably cease, at least for a time.

Nevertheless, recovery at this stage, though possible, is not sufficiently frequent to render prognosis otherwise than grave. Neither must the constitutional influence of so severe a drain upon the system be overlooked. The patient thus suffering is almost always at the very least strumous, perhaps tuberculous, hence phthisis or meningitis are not unusual concomitant of joint disease, especially if the latter taint be present ; while the tendency, in much more sthenic constitutions, of long-continued suppurations to produce lardaceous degeneration of viscera must never be disregarded.

Thus far the actions in the tissues which form or immediately surround the joint have alone been studied, in order that the narrative might remain succinct and clear. To complete the history, we must take into account certain changes of neighboring parts, which, consecutive in character, are not secondary in importance, hardly so in time. Very shortly after the tumefaction of strumous synovitis appears, the limb, chiefly in the segment above the joint, becomes rapidly attenuated. The first change is in the muscles.[2] It has been ascribed to want of use, but there is a cause beyond this mere mechanical one. A fractured thigh in splints, its muscles therefore at entire rest, will not suffer such loss of bulk in three months as will be produced by a fortnight's persistence of strumous joint disease. The mere mechanical theory will therefore not altogether account for the phenomenon.

While the muscles thus waste, the joint assumes a fixed posture, natural in itself, abnormal only in its persistency, toward the side of flexion. This is the case at elbow, wrist, and ankle, while at the shoulder adduction pertains ; at the knee an inward twist of the tibia is usually combined with considerable flexion ; at the hip, very complicated positions, to be studied

[1] The hip is left for subsequent consideration.

[2] Of course as the muscles waste, so do the fat-pads which support and separate them disappear.

in a future chapter, are assumed. These postures obtain in nearly every case of joint disease, almost with the certainty of an unchangeable law.[1] There is then in all joint disease a tendency of the flexor muscles to contract, while the extensors, if not in absolute relaxation, do not, at all events, retract sufficiently to annul such action. It is true that flexors are probably in all limbs stronger than extensors, but in fact a mere examination will show that on the flexor side muscles are rigid, on the opposite side flaccid. Our knowledge is as yet insufficient to account for this phenomenon.

After a time there commence a series of so-called starting-pains, *i.e.*, clonic spasms of the muscles. These begin, as I pointed out in 1860, simultaneously with, indeed are directly caused by, that fulness of the vessels immediately under the articular lamella, which is the hyperæmia of inflamed cartilage. They act in such wise, that during their continuance the joint, which formerly was in a posture of fixed but not abnormal flexion, whose ligaments, however, have been greatly weakened or destroyed by the granulating process described at p. 95, becomes now distorted, or, in other words, there is extreme flexion, often combined with subluxation. In certain joints, as the ankle and elbow, this is less evident than in others. At the knee a backward dislocation, and sometimes an outward luxation occurs, not unfrequently the latter being due to the action of the popliteus muscle.

The contraction of muscles, continuous and clonic, is at first active, *i.e.*, is produced by retraction of the sarkos itself; but they in a short time, thus kept in a state of contraction, undergo fibrous degeneration, the true muscular tissue wastes, and is in part replaced by fat, in part by fibre-cells. The fibrous envelope is thus thickened, and not only hardens itself to the length in which the limb was held by the active contraction, but after the manner of all newly formed fibrous tissue, as that of scars, etc., goes on retracting, drawing the limb still farther out of position. This action, this passive or scar-like retraction, I ventured in my first edition to call by the name of "contracture;" it is, I believe, the same as that which Sir James Paget has termed "adaptive atrophy," also a good term, as it implies the simultaneous wasting.[2]

The retracted and contractured flexors wasting more or less rapidly, thus degenerate into little else than fibrous cords, but the extensors as a rule suffer another form of degeneration; they are, as we have seen, if not absolutely relaxed, at least not contracted, and suffer a fatty degeneration. I do not mean here to draw too absolute a line of distinction; many portions of the contractured flexors will be found in a state of fatty decay; and some portions of the extensors will be found fibrous, but in the former the one, in the latter the other mode of degeneration greatly predominates. The atrophy of the limb is not confined to the soft parts, the bone itself wastes; not merely does it become less in circumference, but its medullary cavity increases; thus, both on its outer and inner surface, the hard cortical part is encroached upon until, as I have seen in amputated limbs, and during resections (see case of C. Lobb, Chapter XX.), the shaft of the bone is no thicker than a calling-card. Such atrophy is more rapid and more complete when the upper joint, rather than the lower, of any long bone is affected. Moreover, if the whole depth of the epiphysis be dis-

[1] I should have made this statement even more absolute had I not seen two cases of knee-joint disease run their entire course without assuming flexion, and had not Volkmann, in Pitha and Billroth's Chirurgie, referred to like cases.

[2] This term excited some adverse comment at the time, in certain reviews, but has since been pretty generally accepted.

eased, that is if the inflammation extends through the joint-end to the epiphysal line, the function of that line will be suspended or permanently destroyed, according to the violence and power of the inflammatory act and to the age of the patient. The bone thus ceases to grow in length at the upper or lower end, according to the site of the disease ; hence, after a severe synovitis commencing early in life, we nearly always find the diseased limb shorter than the sound one. But this has its exceptions ; for if inflammation have not been severe, or, being severe, have not spread in all its intensity to the epiphysal line, the action at that line may have been insufficient to check, but, on the other hand, will have stimulated growth, and occasionally, as a result of synovitis, actual increase of length will be produced.[1] It occasionally happens, more frequently at the hip than at other joints, that complete separation of the epiphysis (diastasis) takes place. In Fig. 3 is an instance of this occurrence at the upper end of the tibia : the malady was osteitis ; but much the same form is presented if such displacement arise in a late stage of synovial disease.

Symptoms.—As the task now before me is to give not merely the local signs of a synovitis but the diagnosis of a scrofulous malady, it is necessary to take into account the appearances, which may lead to the conclusion that a patient is the subject of struma. I believe, as I pointed out many years ago, that a certain confusion has existed on this subject, and that some of the appearances produced by certain diseases of admitted strumous origin, such as phthisis, tabes mesenterica, etc., have been described as diagnostic signs of struma itself.

Struma is not a disease, but a condition of bad nutrition, which marks itself in the aspect in one of two ways, either by an excessive delicacy, thinness and sharp-cut outline of connective tissues, with clearness and transparency of skin ; or by a gross, coarse, ill-concocted condition of the same parts, which therefore are large, blunt-edged, ill-defined, and coarse.

The former of these types is marked by excessive refinement and defined in the modelling of the features ; the cartilages of the nose are clearly outlined ; the eyelids also well carved and defined, frequently fringed with long curling lashes. The conjunctiva and sclerotic are so thin, that the dark pigment of the inner chambers reflects through them a bluish tinge. The pupil is often large and somewhat sluggish, even though the iris be of a light color.[2] The skin is clear and ash-colored, especially about the upper lip and corners of the mouth, and in the very cool-toned shadows looks translucent ; indeed it is actually translucent, for in certain parts, as the temple, eyelids, across the lower jaw, near the angles and the side of the nose, veins are easily seen through it ; the redness of the lips is brilliant and luscious. The whole aspect is that of refined, almost ethereal beauty.

The other type is generally marked by ugliness of the coarsest description. The head is large and angular or "nubbly," is bigger behind than in front ; the great red ears, shapeless and puffy, stand out asplay. The jaws are prominent, the lips thick and ill-defined, generally sway apart ; the nose swollen, and its cartilages ill-defined ; the hair coarse and dull, either dark or gravel-colored ; the eyelids, thick and clumsy, are often bordered with red even when not inflamed, the lash ill-developed and scattered ; the conjunctiva opaque and muddy ; the complexion dull and unclean-looking ;

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[1] See some cases by Mr. S. Jones, and cases related at p. 235 et seq.

[2] Hufeland (Ueber die Natur der Skrofelkrankheit) describes this peculiarity to commencing mesenteric disease ; but I think without sufficient grounds.

the coarse, unctuary skin is marked with large orifices of sebaceous ducts. The figure is usually ungainly; the limbs unwieldly; the joints, hands, and feet large; the belly prominent.

These descriptions are given, each of them, from the extreme limits of their domain; they will serve to mark what I wish to point out, namely, that the state termed struma is one which is closely connected with, perhaps consists of defective interstitial nutrition of all the connective tissues; in the one type apparently by difficulty of assimilation, whence the delicate, but half-starved refinement of cartilages, bones, fasciæ, and of the features formed by them; in the other type by large, probably excessive, assimilation and difficulty of absorption—and we know how much the lymphatic system is involved—hence the sodden, shapeless, almost swollen-looking bones, features, etc. If, therefore, some nutritive defect of connective tissue lies at the root or near the root of scrofula, we cannot but find that an inflammation of such tissue, however set up, must bear and reflect the peculiar character of this evil; in a strumous subject inflammations of connective tissue will be strumous. The more characteristic therefore be the marks of diathesis, the easier will it be to diagnose the specific character of any inflammation.

Strumous synovitis is far more frequent in children and young people than in adults. In them it affects the larger in preference to the smaller joints, is particularly prone to attack the knee and the hip;[1] its next most frequent seat is the ankle and elbow, then the shoulder, and the joints of the tarsus and carpus.[2] When it attacks adults it affects the elbow, carpus and tarsus in preference to large joints.

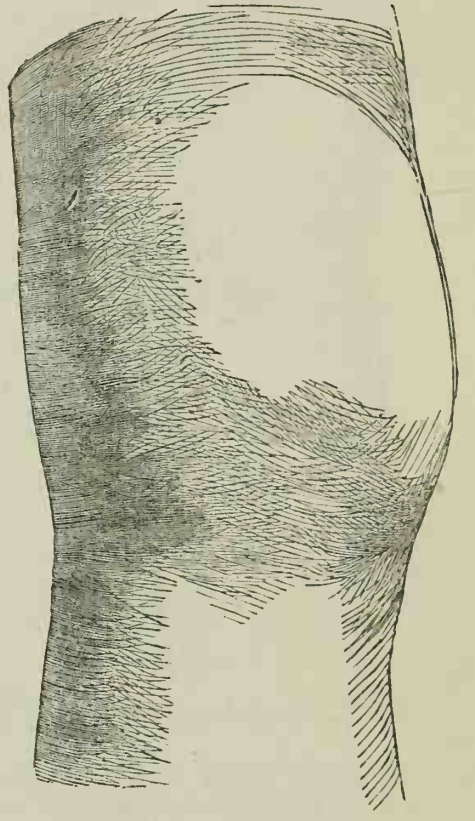

Fig. 10.—Strumous synovitis of knee (early stage).

First Stage.—Chronic synovitis may begin in different ways—either as the obstinate residuum of an acute attack brought on by injury, overfatigue, exposure, or other such cause; and here the history of origin may assist the diagnosis, for a relic of rheumatic fever will hardly be strumous. Or the malady may commence with some obscure pain or sense of weakness, producing a certain stiffness and lameness of the limb; and this condition may persist for a week or more before any swelling is perceptible, at least to the untrained perceptions of nurse or mother.[3] Or, lastly, the first sign of disease may be an utterly painless enlargement, with which the patient moves about and uses the limb as usual, of which he is even unconscious until it is noticed by some attendant. This

[1] As a special chapter will be devoted to hip-joint disease, I shall say nothing concerning its peculiarities in the present place.

[2] In most cases of tarsal and carpal disease, it is not possible to diagnose synovitis from osteitis.

[3] The gentle commencement of the disease alarms so little, that the limb is seldom immediately subjected to surgical examination hence; the time when swelling commenced is in most cases uncertain.

last is in my experience the manner in which the worst and most obstinate cases commence ; it occurs only in those constitutions strongly marked by strumous taint. Cases thus beginning assume the form which Sir B. Brodie called a morbid change of the synovial membrane, and which he considered as a semi-malignant form of disease.

When the first and second mode of commencement obtains, the swelling will at first have much the form of the synovial membrane ; but this condition is very short, and corresponds only to the few days when there is some increase of fluid in the joint, and very little new tissue in and around it ; in this state the swelling fluctuates slightly. Some time after the disease has begun in this manner, the joint may actually decrease a little in size, and the tumefaction left will be no longer fluctuating, nor so soft as previous to the diminution. Instead of conveying to the practised finger the sensation of confined fluid, it gives that of a soft solid ; the decrease, under these circumstances, is of no good omen ; the fluid may have almost disappeared, but there has been, instead, formation of gelatinous tissue. From this time the condition will be the same, whatever may have been the beginning of the disease ; the joint will continue more or less gradually to swell, the shape of the tumor becoming very different to that of an acute synovitis ; its chief characteristic is that of shapelessness ; its form is not affected by the position of tendons or of ligaments ; but includes them all in its vague boundaries.

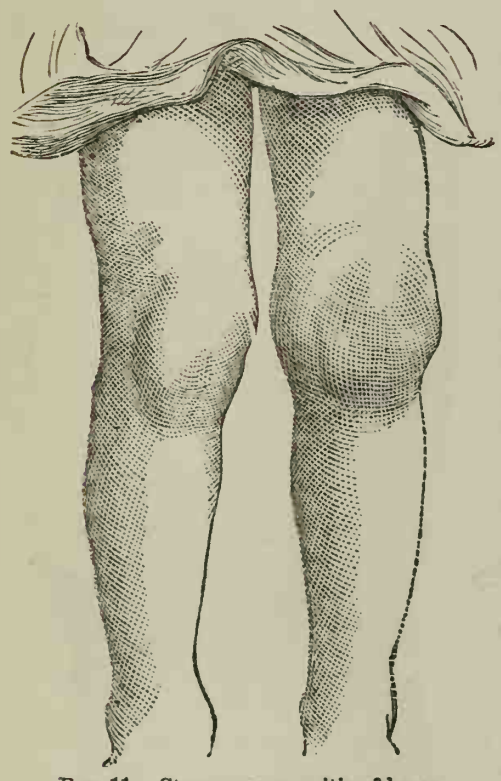

Fig. 11.—Strumous synovitis of knee.

The sensation which the tumefaction conveys to the hand is soft and boggy, such as, to the educated finger, may give the idea of fluctuation. Many parts of the swelling are softer, and some parts a little harder, than the general mass. These soft spots are not more truly fluctuating than the others ; the increase in softness is all that can be observed about them. The harder parts seem to lie in the mass, to have no defined boundaries, and cannot be separated, lifted up, or seized by the fingers. This swelling conceals and covers the bones, which can only be felt through it ; their prominences and depressions muffled and rendered indistinct by the doughy thickening of soft parts around. It is at this stage that the distinction between a strumous synovitis and ostitis can without difficulty be made in all but very deep or small joints, as the hip, or the tarsal and carpal articulations. The distinguishing mark is chiefly the fact of a soft swelling covering, as above described, bones which are not enlarged ; while in ostitis, although some swelling of soft parts can be detected, it is much less than in synovitis, and the increase of size, by making rather firm pressure between the finger and thumb at one and the other side of the joint, will be found to be clearly bony. If the plates illustrating Chapter VII. be compared with those now given, the distinction will be obvious to the eye. Of course it is only in very typical cases that visual diagnosis can be made ;

but the principle is the same to the touch and to the sight: in the first stage of strumous synovitis the swelling is situated in the soft parts—is itself soft; bony enlargement cannot be made out, but, on the contrary, the soft swelling beneath the skin covers and conceals the bones. In osteitis the enlargement, although the soft parts may be somewhat thickened, is osseous,[1] and one or the other bone forming the joint, even one or another part of the bone (as inner or outer femoral condyle) may often be felt, even seen to be enlarged.

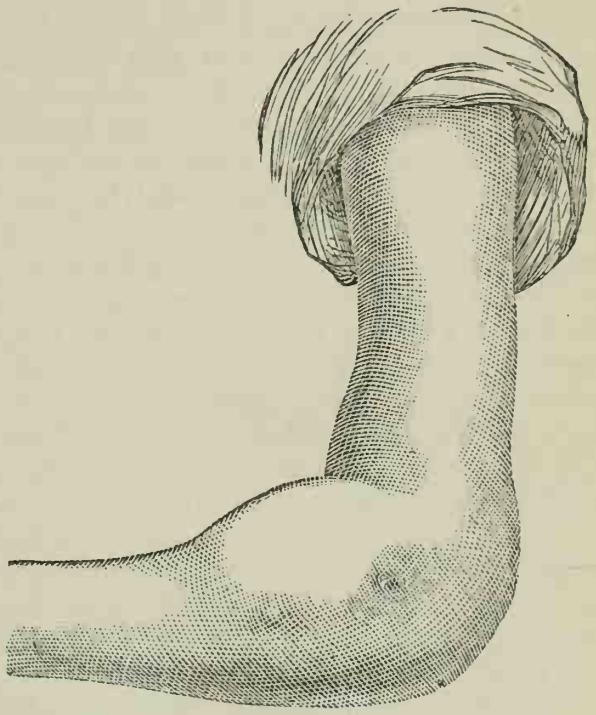

FIG. 12.—Strumous synovitis of the elbow.

The enlargement, although described as shapeless, in contradistinction to that of acute synovitis and to osteitis, is nevertheless not without form; indeed, every joint has its peculiarity, which some experience will teach better than mere description. The engravings may aid, however, in directing observation aright. The shoulder thus affected is especially, and par excellence, shapeless, a mere rounded swelling at the top of the arm. The elbow presents in front two conical enlargements, each with its base toward the joint, each diminishing as it is traced toward the upper and forearm respectively. The forearm tumefaction is chiefly on the radial side, at the back above the olecranon, and on each side of the triceps tendon. The swelling of the wrist is chiefly at the back, and although it may encroach upward and downward, it has its long axis across the limb, and in looking at it in a good light falling lengthwise from the hand upward, a line of shadow above the radius, a high light and reflection over the situation of the joint run both in that transverse direction. The peculiar round form of the knee, and in synovitis the absence of any predominant swelling on either one side or the other, have already been noted. When the ankle-joint is diseased there is often some difficulty in the diagnosis. It is to be distinguished from thecal enlargement by the direction of the swelling, which is transverse to the axis of the limb, as also by the fact that in joint disease the whole circumference, behind the malleolus as well as in front, is enlarged. In swelling from dropsy or suppuration of the sheaths the tumefaction is in a direction parallel with the limb's axis, and it is very rare that the posterior and anterior sheaths are both affected. At p. 130, Fig. 15, an ankle is represented as seen from behind; the dis-

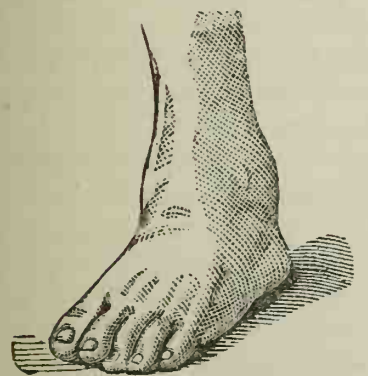

FIG. 13.—Strumous synovitis of the ankle.

[1] For description of this form of swelling, see chapter on Strumous Ostitis.

ease had advanced to suppuration on the inner side ; hence, that part is rather more protuberant.

As the soft swelling increases, the joint becomes by degrees whiter than normal. This peculiarity is the more marked the more strumous be the case, so that we may roughly conclude, from the color of the skin, on the sort of granulation forming beneath it. The symptom was that which caused Wiseman, in 1734, to apply to this disease the name of white swelling, a name which has fallen into disuse in England, though its synonyms, tumeur blanche, tumor albus, etc., are, or have been till quite recently, retained on the Continent. When the case is far advanced, this whiteness is very striking ; and in some cases where the granulating, the first stage of the disease, is prolonged, and the swelling therefore very considerable, the skin becomes stretched and polished ; beneath it may be seen meandering a few veins, which, being flattened out by the growth between them and the skin, look broader and bigger than the norm.[1] In estimating the amount of swelling by the eye alone, the surgeon must take care not to be misled by the atrophy of the muscles which accompanies this disease. Of course such shrinking of the limb is most deceptive if the diseased joint be in its middle, as the elbow or knee. I have often heard tumefaction spoken of as enormous when accurate measurement has shown it to be slight. Heat of a joint thus affected is only present quite at the commencement of certain cases, when the condition might be better named subacute than chronic ; it may also be a fugitive symptom, occurring at night in a further stage of the malady. I have thought at times that a joint in the early stage of this disease felt even colder than the norm, but observations with the thermometer have never verified this notion.

The pain accompanying this form of disease is very variable. In some cases all the first stage is, unless the joint be much moved and worried, all but painless. It is true that a child thus affected will often wake suddenly from sleep and cry for some time,[2] an act which is perhaps often caused by an unconscious movement of the limb, producing a stab of pain. In hospital, as in private practice, children with greatly swollen joints are frequently seen with countenances that bear no mark of suffering : now any continuous pain, or any frequently reiterated pain soon leaves its mark on the facial expression. Among older persons, from whom definite complaint may be elicited, pain while the limb is at rest is not a prominent symptom. A dull aching, worse at night, or a gnawing, a sense of distention, are mentioned, but not with any marked emphasis. In one case that occurred to me in 1858, a feeling of intense cold in the joint was the most prominent sensation. I cannot attach any value, diagnostic or prognostic, to the sort or amount of pain complained of at this period of the disease.

Besides pain when the joint is undisturbed, we must consider tenderness, *i.e.*, pain produced by pressure. Every joint affected with synovitis has its own particular spot of tenderness, which in some joints is also the spot to which ordinary pain and the shock of starting-pains are chiefly re-

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[1] This enlargement of veins is a constant appearance in all cases when a more or less deep-seated tumefaction grows with some rapidity toward the skin ; it occurs in encephaloid, in many sarcomata, in rapid suppuration of a joint-membrane. It is not, therefore, pathognomonic of any form of disease, but only of the locality of growth ; but the quicker the growth, the more marked and numerous are the veins ; hence, while in encephaloid a whole meshwork of enlarged venous radicles net out the surface, in strumous synovitis only a few not greatly interlaced markings appear beneath the skin.

[2] I am not here speaking of the so-called starting-pains, to be hereafter described.

ferred. At the shoulder this spot is in front, just below the acromion, in the elbow, the back where the radius is jointed to the humerus. At the wrist it is at the back, outside the extensor indicis tendon. At the hip, if there be pain at the commencement of the disease, it is situated at the inside of the thigh, just behind the origin of the gracilis muscle; afterward it shifts and fixes itself behind the great trochanter.[1] At the knee it is situated on the inner condyle, just inside the edge of the patella. At the ankle about half an inch in front of the outer malleolus.

These spots of chief tenderness are so constant that their existence may be received as an absolute rule, although exceptions do now and then occur. I have been quite unable to find, by the most careful investigation, any cause for this localization of tenderness; we must at present be content to accept the simple fact.

This description applies to the larger joints; compound joints formed of small bones (carpus and tarsus) often yield few signs by which we may certainly distinguish synovial from osseous struma, since the one very quickly succeeds the other.[2] The malady at the wrist usually assumes the form shown in Fig. 36, which was originally synovial. This formative phase of the disease lasts in some cases a very considerable time without the occurrence of any other morbid change, and then frequently comes a period of passivity; the swelling neither increases nor decreases, pain is not complained of, the patient ceases to lose, but does not gain much health, although sleeping well, eating fairly, but often unable to take exercise he continues somewhat pale and weakly. The joint is not painful, though it probably, if permitted, assumes a more exaggerated position, immediately to be described; it is not hot nor tender. There appears no inflammatory change, either progressive or plastic, the especial spots of tenderness give some slight response to pressure. By far the larger number of cases have this period of stasis, lasting in some but a short, in others a very long time. The wards of some hospitals are cumbered with splintered children, getting neither better nor worse. After this period comes on a phase either of progress or regress.

This latter invasion of cartilages and of bones, degeneration and suppuration, is sometimes very rapid, and it is the rapidity of such events which appears to me to lead some eminent men to doubt the possibility or even desirability of making any distinction between strumous maladies commencing in the hard or in the soft parts of the joint.[3] But these cases are by no means the most usual; and even were they more common than they are, such occurrence cannot be used as an argument against accepting a frequently clearly marked distinction, which must greatly add to the precision of prognosis, and often to the great advantage of treatment.

However—and this is the chief reason of my mentioning it here—a considerable variety in the rapidity of different cases leads to some difference in the precise pathological moment at which those important manifestations, fixed posture, abnormal mobility and subluxation, occur. Some account was given of these processes in the former division, and confession made of my inability to find reason for the perverted reflex action producing them.

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[1] For further account, see chapter on Hip-Joint Disease.

[2] Hydarthrus of the carpal synovial membrane (a rare disease, which I have twice seen) gives a proximate idea of what a fungating disease remaining purely synovial would be like.

[3] See Volkmann in Billroth's and Pitha's Chirurgie, Bd. ii., p. 521; Holmes's Surgical Diseases of Childhood, p. 425.

The fixed posture, always to the side of flexion, generally commences during the first, but becomes more marked during the second stage of the disease; in some joints, as the ankle and elbow, pure flexion obtains: at the shoulder adduction, probably the expression of flexion at this joint. At other places, as at the hip, flexion is complicated by several additional postures, which will be studied in a separate chapter. At the knee flexion so greatly predominates that a certain inward twist of the tibia, which generally, if not always, coexists, is generally overlooked. While the postures are thus becoming persistent, the limb shrivels very rapidly. On examining the state of muscles, the extensors are found to be flaccid, while the flexors are more contracted, though not firmly so; any attempt to straighten the joint, or even a belief that such an attempt is about to be made, causes these latter muscles to become at once rigid.

Abnormal Mobility.—The term implies that the bones composing the joint can be moved by the surgeon's hand in directions impossible to a normal articulation. At the knee the tibia may be made to glide laterally on the femur, or may be rotated, or may, while the knee remains straight, be moved from side to side. At the elbow the ulna may sometimes be made thus to move laterally, or when the joint is bent at a right angle the radius may be moved up and down. At the ankle a backward and forward movement may be produced. As such conditions have been shown to arise from breaking down or absorption of the ligaments, this symptom is a sign of the intensity of the disease, and of its destructive invasion of tissues, necessary to the joint as a centre of motion. It must, however, be said that any considerable false mobility is rare in this stage of the disease; still more infrequent is subluxation, save at the knee a slight displacement of the tibia backward, which is not uncommon even in this first phase of fungating synovitis.

The Second Stage is ushered in by certain peculiar symptoms called "starting-pains," being a combination of pain and of muscular spasm, but which of the two has the priority in point of time and causation is impossible to say. The pain is always referred to the special points of tenderness already (p. 110), mentioned, although it radiates up the limb. The startings rarely occur in the daytime while the patient is awake; but at night, just as he is falling to sleep, rouse him with a sudden stab of pain and a sense of horror; indeed, many regard these attacks with such dread that they keep themselves awake as long as possible in order to avoid, or at least postpone, their advent. When slight, they do not visibly move the limb; in their more severe form, as I have frequently seen, the limb, with even the splint upon it, jumps a little way from the bed. Young patients frequently cry out loudly, yet may, even before the nurse can reach them, fall asleep again; others refuse to sleep, and beg not to be left alone. The advent of these pains is most important, as marking the particular pathological phase of the disease; while they are severe, and increasing ulceration of cartilage is imminent,[1] or has already commenced, they are indeed directly caused by the hyperæmia immediately under the articular lamella, which always accompanies that process. This fact, which I first pointed out twenty years ago, has been generally accepted as the correct interpretation, leading to a clear comprehension of the actual occurrences taking place in any given case of joint disease. These pains, which are remittent and transitory, are generally coincident with a certain form of constant pain, usually described

[1] It will be pointed out in another chapter that these, the more severe form of pains, are earlier in strumous osteitis than in synovitis.

by the patient as "gnawing" or as "soreness of the bone;" in some cases a sense of distention, a bursting pain is mentioned.

When these sensations, the more or less constant and the irregular, have lasted a certain time, longer if they have been slight, shorter if severe, another symptom is added, viz., tenderness on pressing the joint-surfaces together. The origin of this symptom, although extremely obscure, I believe myself to have detected. By questioning minutely for years every patient that came in my way, by observing the species and succession of different sensations, and examining, when possible, the joints of those whose symptoms had been thus noted, I have come to the conclusion that this tenderness indicates that the articular lamella has given way over a larger or smaller extent, and that the cancelli are laid bare to the joint. The actual sequence of events can in most instances be traced, the starting-pain coming on first—two or three weeks, or even more, before the tenderness supervenes. Having examined a very large number of joints, in all sorts and conditions of disease, and having, wherever it was possible, compared the symptoms with the morbid anatomy, I can affirm that I have never heard complaint of this peculiar joint-tenderness without finding the articular lamella broken through. I have found the lamella given way in cases where there had been no joint-tenderness; but then the breaches of continuity had been either very small, or situated in some part, where, in the position of the limb, it could not be pressed upon by the other bone of the joint. In seeking this symptom, extreme care must be used lest the limb be moved; motion, either flexion or extension, of a diseased joint often causes pain which is not that being looked for. Again, we must not let the patient involuntarily deceive us; many persons who have long been ill with articular disease habitually complain when the joint is touched, whether they be hurt or not, being moved thereto by fear that something to give pain is about to be done.

Grating or bony crepitation in the articulation is a symptom which, when it occurs, proves an ulceration of cartilages throughout, probably a considerable extent of both bones; but the absence of this grating by no means proves that the cartilages are sound, for granulation from the bone may be so luxuriant as to prevent the two osseous surfaces coming in contact. It not unfrequently happens that, during some part of the progress of the case, the bones will grate, and that afterward they will altogether cease to do so. The reason of such cessation is, after what has just been said, perfectly evident.

In this series the symptoms usually succeed each other in case after case with an almost monotonous iteration, yet sometimes variations occur, produced either by great nervous irritability or more generally by extreme instability of the granulation-tissue, causing the third stage, that of degeneration, to supervene even before the second is well established, thus mixing up the symptoms of the one with those of the other.

Generally during this second phase, especially if it continue a considerable time, the starting-pains are followed by further effects. One of these is more complete and permanent shortening of muscles—contraction is succeeded by contracture. This change takes place very gradually; hence, it is impossible to mark exactly the time of its commencement. A muscle slightly contractured feels but little different from a normal one; but when the process has somewhat advanced the stringy feel of fibrous degeneration can plainly be distinguished. These, shortening and the spasm combined, acting on a somewhat loosened joint, may even now begin to produce subluxation, but this condition is more fully developed in the later phase.

The Third Stage embraces one of two actions, either progress toward cure, or toward destruction of the joint by degeneration, suppuration, or caries.

The former of these may occur at any phase of the disease, and the earlier the better will be the result. The signs of such beneficial change will be, firstly, improvement in the general health, more marked if it have previously considerably suffered; the improved appetite, increasing strength, cessation of night-sweats, of starting-pains, as well as a more even thermometer at a lower grade, indicate a better condition of system. Locally, there ensues a decrease of swelling, together with greater hardness and resiliency of the enlargement; improved coloration of the skin over the joint, while the meandering veins, if there have been any, and any slight abnormal mobility, disappear. The shape of the bones gradually becomes more perceptible, and they are not so far from the surface. If when these actions set in the first stage have not been passed, the limb will recover with merely an amount of joint stiffness (the result of thickening), which in time may be eliminated. If the second stage have been reached, a more severe lameness, greatly to be alleviated, but perhaps never to be quite overcome, will be left behind. If the destructive processes of the third stage have proceeded pretty far, a joint partially stiffened by false or quite stiffened by true anchylosis is the best result attainable.

The hardening of the swelling and its diminution is a more or less rapid or slow process, according to the energy of the formative acts which the hitherto all but unchanging granulation-tissue has assumed. As it goes on, the skin becomes more and more drawn inward to the bones, and at length, if considerable swelling have been present, becomes stretched over them tightly—*cicatricial contraction*—the joint loses not only abnormal, but also normal mobility to a very great extent; and when the process is complete, the new fibrous tissue, fully formed from the granulations, binds the bones firmly together, often so rigidly that only a little doubtful movement can be obtained; this is false anchylosis. (See Chapter XIX.)

True anchylosis, viz., the ossification of the fibrous tissue, frequently follows upon the false with very considerable rapidity, but is in other cases a slower process. It announces its commencement by no distinct symptom; greatly increased, and at last complete immobility indicates a little later what actions are or have been taking place.

A great many joints thus diseased do not go through this stage of cicatrization regularly and *pari passu* over the whole area of morbid action, certain parts in some cases will solidify, others degenerate and suppurate. At certain times, according to fluctuations of systemic health and vigor, the one or the other action will predominate. Yet any attempt at this mode of healing, sufficiently marked to be detected, is of encouraging augury, and should be fostered, as it has great tendency to become more widely propagated among the tissues. Yet, only too frequently, the contrary actions prevail, sometimes mingled with fitful attempts at healing; and usually slowly, at other times very rapidly, all the new growths and the parts involved in it appearing to break down almost at once into degeneration and abscess. The general and local symptoms will vary accordingly. The advent or approach of this condition may be suspected if the thermometer, fluctuating considerably, fall during the daytime below 98°, while a sudden sharp and persistent rise marks the commencement of rapid disintegration.

If also the tumor of the joint do not diminish, but continue to increase without sign of active inflammation; if the articulation become more loose

in abnormal directions, we may feel assured that degeneration and suppuration will probably occur; if the skin become whiter and more polished and lose its mobility, while the tumor continues to enlarge; if the softening mass feel as though it were immediately beneath the surface, we may conclude that those retrograde actions are imminent, or perhaps have actually begun.

The tumefaction usually increases, and if this increase be general it gives to the whole swelling a still more rounded appearance; the skin over it is either dry and furfuraceous, or if the enlargement be sufficient to produce tension, smooth and polished; under these latter circumstances, if considerable pain, of a dull aching character, be experienced, and if a certain pyrexia, well marked by the up and down movements of the thermometer, be verified, acute *intra-articular* abscess will form; it is not a very usual result of fungous synovitis. Frequently it is not the whole inner wall of the new tissue which thus degenerates, but one or more spots in its thickness; such *peri-articular* abscesses may exist a certain time without making their presence known by any distinctive symptom; unless they be of rapid formation or near the surface, they may even open into the central cavity without exciting more than a suspicion of their presence. After a time, however, they approach the skin, and then a local enlargement, a rounded protrusion of a part of the intumescence, will appear, and over this, unless it be incised, the skin will redden, frequently over a large surface, and break, giving exit generally to only a small quantity of ill-concocted, flocculent pus. The opening thus formed may rapidly degenerate into a sinus, from the mouth of which sprout large, flabby, and generally pale or greenish granulations; or if the pus have previously undermined a wide extent of skin, a large flat ulcer, around which the skin lies loose on the subjacent tissue, is left. There is some difference in the behavior of these abscesses, according as they are more or less deep or superficial; the latter may open anywhere about the joint. The former generally make their way first into the central cavity, and then, like the intra-articular abscesses, open outward in certain spots which are more definite for the deeper than for the superficial articulations—as for the shoulder and hip—the choice locality in the former instance is just inside the biceps, about half an inch from the edge of the great pectoral muscle, for the latter are several spots described in another chapter. *Adjacent* abscess, either intermuscular or periosteal, though unusual in this form of disease, should nevertheless be looked for. They produce, the former, certain lines of ful-

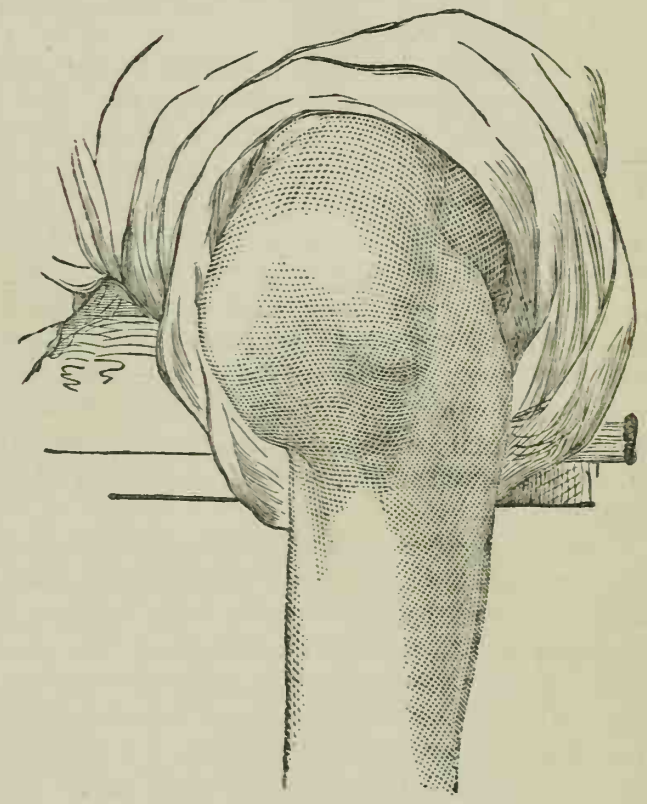

FIG. 14.—Pathological dislocation of the tibia outward.

ness rather than of hardness, running from the affected joint upward, very rarely downward; the latter a sense as of increase in size of the bone. Their mode of detection is more fully described elsewhere.

While the granulation-tissue thus softens, the ligamentous fibres enclosed and permeated by them share a like fate, and subluxation or complete dislocation is a common event at this stage, especially at the hip, knee, shoulder, and upper radial articulation; that at the hip is of all complete pathological luxations the most common. The radius is often dragged upward by the action of the biceps, but the displacement is rarely entire. The tibia is generally drawn backward on the condyles, so that a marked deformation of the joint results, namely, the lower end of the femur makes prominence in the patellar region; below it is a marked depression, while behind, the lower part of the popliteal space projects abnormally backward. Occasionally, too, at this joint, a very singular displacement outward of the tibia is too well marked to require any description. The outer condyle of the femur rests on the inner articular facet of the tibia, while the inner condyle has lost its opposing bone. The shoulder, rarely the seat of strumous synovitis, tends, when thus affected, to dislocation toward the axilla.

Sometimes, whether luxation occur or no, the patient may fall into a state of considerable weakness, when the degenerations above described become more rapid, are not confined to spots here and there, but take place almost simultaneously throughout. Thus the whole mass may more or less rapidly suppurate or suffer fatty degeneration; fluctuation over the whole space will be evident, and when the pus is evacuated, it brings with it parts of the fibrous tissue which have been included in the granulations, and also bony detritus from the cancellar walls which have been similarly involved. Such local changes are accompanied by considerable general disturbance, inedia, emaciation, and night-sweats, together with very strongly marked thermometric derangements, the temperature being nearly or even below normal in the morning, and rising to 102° or more in the evening. Surgery usually spares to the patient these ultimate sufferings of joint disease.

Omitting this last described phase, it must be noted that from the former condition, *i.e.*, from peri-articular and intra-articular abscess, patients may yet recover, of course with anchylosis. Such favorable course is marked by decreased violence of the starting and other pains, and by diminution of the swelling, which becoming harder seems to press the pus out of the abscess cavities, and the discharge decreases in amount, altering its characters from a flocculent ichor-like fluid to good creamy pus; as time goes on, this may afterward again become thinner, but then resembles thin mucus or serum. The granulations become of a healthier character, they protrude less and less, come to lie on a level with the skin, then are as it were sucked in as a snail into its shell, sit below the level of the surrounding surface, and when healed, form what is called a depressed cicatrix. This retraction of the sinus granulations is merely a part of the general cicatricial contraction that is taking place, whereby the tissues consolidate, and may become even abnormally hard. Indeed in the cases which originally were marked by very considerable puffy swelling, the tissue-contraction is so great that the joint, when fully healed, is smaller than the norm, and the skin seems drawn close to and between the bones. A limb which has gone through these processes of disease and repair exhibits shrunken and feeble muscles, a joint formed by small and more or less misshapen bone-ends, to which the skin, much changed, smooth and shiny,

is closely attached; while at varying distances from the joint, depressed, reddened cicatrices mark themselves very plainly.

Treatment—General.—It perhaps hardly comes within the scope of the present work, nor is it otherwise advisable, to enter into any long treatise on the treatment of struma. Yet is evident that, in dealing with a disease which takes root in a certain state of system, all attempts at cure would be fruitless, unless some means were employed to alleviate the constitutional evil. In the first place, all hygienic measures must be taken—close dwelling-rooms are to be ventilated; light admitted to the fullest possible extent; unhealthy diet changed, and cleanliness inculcated. Upon these plain rules of living we need not linger.

Two different aspects of strumous disease were described at page 106, with some care, because they ought to indicate two different forms of treatment. The distinctions, although frequently as strongly marked as there indicated, do not always diverge to that extreme degree; therefore, the treatment to be described for each will not always be so opposed but that their principles may be somewhat intermingled.

That form of scrofulous disease, which is marked by thick unwieldy connective tissues, is in adults very generally, in younger persons invariably, combined with a sluggish intestinal canal, accompanied usually in the latter instance with thread-worm. The whole tube is lined by a thick viscid mucus, which does not stimulate the peristaltic actions, nor permit either food or remedies to come in contact with its mucous coat. This matter must be purged away, and the best means for the purpose is a powder of calomel and jalap or calomel and rhubarb. In another chapter (see Chapter XI.) the action of this remedy in articular disease is compared with its effects in strumous ophthalmia. We can, in this latter malady, actually see the morbid symptoms decline as soon as the intestines are clear. In strumous synovitis the benefit is not less certain, though it may be less plainly perceptible. In one or two cases of commencing strumous joint disease, the exhibition of this remedy, combined with suitable local means, has checked the complaint. It not unfrequently happens, that after the medicine has had its due effect, the complexion will resume its muddy hue, and the eyelids become again red; the dose should then be repeated; but proper dietetic and medicinal measures will prevent the necessity of recurring to the purge more than once or twice throughout the whole complaint. Small alterative doses of mercury may, however, be given for a day or two with advantage. This medicine is not in these cases to be pushed to any point near affecting the gums; it is simply to correct the secretions, and is the more beneficial if it produce rather free action of the bowels. For this purpose, it may be advantageously combined with quinine; as, for instance, two grains of the gray powder with one of quinine, night and morning for two or three days, and then the latter may be administered alone twice or thrice in the twenty-four hours.

Iodide of potassium is especially indicated; it may be given in some bitter infusion. I have been in the habit of using the following formula, a little altered from one of Lugol's, the action of which is quicker than the iodide alone:

℞. Iodide of potassium..... 1 drachm.
Tincturæ iodi..... ♏ viij.
Infusion of calumba..... 1 pt.

It is singular that the addition of the pure element detracts from the metallic taste of the compound, and renders it less lasting. The formula

appears, in some of the reported cases, as the Mistura Potassii Iodidi Composita.

Quinine, mineral acids, and bitters, are the tonics most beneficial in this form of the disease. Iron is far less valuable, and cod-liver oil very frequently disagrees, besides aiding the tendency to clogging of the intestines and sluggishness of the liver.

The form of struma, which is distinguished for the fine delicate formation of the connective tissues, is to be managed on a different plan. Purges and mercury in any form must be avoided; the inaction of the intestinal canal is to be combated by mild vegetable aperients; rhubarb given in pill immediately before or with the last meal at night is an excellent plan, and anything like a violent or irritating evacuant does harm. Iodide of potass alone in the most typical cases of this sort of struma is not beneficial; the whole class of alteratives are not needed.

On the other hand, tonics are extremely valuable. Cod-liver oil is especially indicated, as we desire increase of nutriment; in these cases it very seldom indeed disagrees. Quinine, if the appetite fail, is useful; but iron is to be much more highly prized. I have found great benefit from iodide of iron, but have no esteem for the usual preparation, the syrup; I give it in a nascent form, prescribing it in two mixtures, two or three grains of iodide of potass, and five or eight minims of tincture of iodine in the one, five grains of citrate of iron and ammonia in the other, a dose from each is mixed just before taking; in fact, I esteem steel and the oil as the best medicinal agents: where the latter has been found unsuitable, sarsaparilla may be advantageously administered. Malt liquors, milk, if possible cream, should be included in the diet. It may be pointed out that in these cases the stomach is usually capable of managing only a little food at a time; therefore, the meals should be small and frequent. I have often found that these patients are very languid in the morning, feel faint and are not able to eat breakfast; on inquiry, it will often be elicited that they take no food, after a meal about six or seven in the evening, till breakfast-time; an interval often of fourteen or fifteen hours, which is more than their powers will bear. They may be told to eat a piece of bread and butter about half an hour before going to bed; they will then not only sleep better, but wake less languid. When there is much debility I have found advantage from ordering something before rising in the morning.

The value of all treatment lies in its adaptation to the particular case. The distinction between the form of scrofulous affection has been drawn broadly and strongly; they are not always, however, so clearly outlined; but so convinced am I by experience of the advantages of separating the two sorts, both in diagnosis and treatment, that it appears to me impossible to insist too strongly upon their varieties.

Local Treatment: First Stage.—Some little difference in the first application of local treatment will arise according as the surgeon sees the case quite early in the disease, or only after a certain time has been allowed to elapse. In the earlier part of the first stage there is no doubt, whatever may be the case afterward, that rest is the most, I had almost said the one important indication. To be beneficial, this rest must be not only perfect, but must be combined with a good position. Hence, if it chance that the surgeon is first called in, when some malposture is already established, it will be his first duty to reduce the limb to a proper position. The mode of doing this, under the influence of an anæsthetic, has been already described (p. 56). I need only say here that, however fixed and immobile a joint in the early part of strumous synovitis may appear, while the patient

is awake and sensible, the fixity always disappears, as soon as unconsciousness is produced, and the surgeon may, without any force, place the limb in a proper posture, and affix such apparatus as he may prefer, be it splint or bandage. In a later part of this first stage, whenever such reduction becomes necessary, more power may have to be used; at the same time great caution is necessary, since in joints, which have not deep cavities, as the knee, the radio-humeral, and shoulder (but here such replacement is very rarely necessary), a certain amount of subluxation is very readily produced, more especially if the swelling be soft and large.

When the proper posture has been gained, the limb must be carefully put at entire rest, either by placing it on a splint of metal, wood, or moulded leather, or by the use of a starch or plaster-of-Paris bandage. The value and mode of rest, the advantages and disadvantages of the immovable plaster-bandage, have been already discussed. I need only in this place more especially insist on the necessity of compressing the joint itself to a degree at least equal to the pressure on the rest of the limb. I believe myself to have seen several cases, in which such bandage became a means of injury, rather than of benefit, through the neglect of this precaution. Therefore I recommend in these cases that the joint be enveloped in one or two layers of cotton-wool, placed outside the flannel-bandage with which the limb is firstly covered, and that over this pad the plaster-band be strained more tightly than over other parts. Pressure, as we shall see immediately, is advantageous if it can be evenly applied; smoothly arranged layers of the wool will graduate and regulate the compression of a well-applied bandage.

One disadvantage of the plaster-of-Paris is its very considerable weight; a drawback which is not felt if the patient is to remain in bed. But under certain circumstances, hereafter to be detailed, we may wish our patient to get about, even if the lower limb be affected, and we shall always desire such liberty if the joint be one of an upper limb. Hence in such circumstances, the gum- or starch-bandage—which is exceedingly light but a little less firm than gypsum—can be conveniently substituted. Another drawback may be that we cannot get at the surface in order to apply any further curative treatment. I use, therefore, irremovable apparatus only when the swelling is not very soft; when the inflammation, being traceable to some definite irritation or accident, leads to the belief that the constitutional cause is less potent than in cases of independent origin; or again, when certain signs show that other applications having been successful, and for the time sufficient, I wish to intermit them. Under such circumstances, the irremovable apparatus, insuring as it does a very perfect form of rest, is invaluable; but the practice of putting up every inflamed joint in a plaster or dextrine case, and considering that herewith the ultimate word of treatment has been said, must be highly deprecated.

In Germany, extension, or, as there termed, "distraction of the joints,"[1] has been abundantly used and extolled. The perception, that the cartilages most readily ulcerate where the two bones are in contact, has led to an exaggeration in the use of this treatment. The idea, that by such traction the bones could be drawn asunder sufficiently to make more room for the intra-articular effusions, and thus diminish tension, has been, strange as it may seem, seriously entertained; now, although cartilages ulcerate most rapidly at the points of pressure, it is very doubtful if pressure ever pro-

[1] Volkmann's Neue Beiträge zur Pathol. Therap. der Krankheiten der Bewegungsorgane.

duces either the inflammation or the degeneration, which may lead to their destruction; rather is it the fact that, these actions having been set in, the altered cartilage perishes more quickly under the influence of some compression. As to the influence of tension on articular capacity, my friend, Dr. Reyher,[1] made some careful experiments by introducing a glass tube into the knee-joint through a hole bored in the patella; the articulation was then filled with fluid, which was also allowed to occupy half the tube. A weight was then suspended on the limb, and the liquid in the tube rose considerably. Thus the capacity of the joint is absolutely diminished by "distraction," probably through tightening over it of the skin. At most joints (for the exception of the hip, see Chapter XIV.) weight-extension may somewhat diminish the contact pressure between the two bones, and thereby perhaps retard the disappearance of already inflamed or degenerate cartilage; used with this design, it comes more properly under the second-stage treatment. It likewise is a method of obtaining rest and maintaining position; but other effects—antiphlogistic, absorbent, or otherwise—cannot be attributed to that treatment.

In the first stage, then, of a strumous, as of other synovial inflammation, we must recognize, as the great essential of treatment, firstly, a good position; secondly, total and entire rest, not only of the joint itself, but of the muscles moving it. The means of obtaining this rest, and at the same time of avoiding injury to the patient's health, must be left to the judgment of the surgeon. As some aid to choice the following hints may be useful: In cases which have begun in some traumatism, however slight, or, at least, with a distinct attack of pain at a definite time, the causation lies, probably, less in a constitutional cachexia, than when the contrary mode of commencement pertains—and this probability is heightened if the general signs of struma (p. 11) be absent, or, at least, not strongly marked. If, therefore, under such circumstances, the joint-enlargement be not of the peculiarly soft, doughy, and pseudo-fluctuating character, which indicates a great heaping up of embryonic tissue, it is probable that in such cases rest, as above defined, with attention to health, will effect a not too tardy cure. Let us take this class of case first. If the disease be situated in an upper limb we may, with much ease, follow out both indications, placing the segments above and below the articulation in a carefully applied starch- or dextrine-bandage, taking care that, at least, as much pressure falls on the joint as on the parts above; we let the patient take sufficient exercise in the open air and use, if desirable, as is generally the case, some of the medicaments already mentioned.

If, on the other hand, the diseased articulation be the knee or the ankle (hip disease is here omitted) such facilities for treatment do not exist. Under the circumstances, above postulated, I consider it, as a very general rule, wise to keep the patient a certain time in bed; if the child be still small to apply a moulded leather or poro-plastic splint, extending well above and below the joint, and reaching more than half-way round the circumference of the limb. If there be evidence of pain or of tenderness at its peculiar seat (p. 31) it is well to apply cantharides—not so as to blister, but to stop short of vesication—and to repeat it, alternating its position to different parts of the limb after the manner more fully described at p. 36. If, in from a week to six weeks, according to the case, these means have been successful in relieving the tenderness and somewhat reducing the swelling, the child may be permitted to get up, under careful arrangements

[1] Deutsche Zeitschrift der Chirurgie, Bd. iv., S. 26.

as follows: either the limb may be put in a starch-dextrine or water-glass bandage; or, if it be thought that some local appliance may still be needed, in a well-fitting double case of leather or poro-plastic felt; that is to say, a case consisting of two halves, one for the outer, the other for the inner aspect, so as to enclose and thoroughly support the limb, and yet be removable. The child may then be taken, if other circumstances permit, into the open air to lie down, or may, in some cases, even in this stage, be allowed a high shoe on the sound limb and crutch, after a method to be described immediately.

A few modifications may be made according to certain circumstances. If the patient or his parents be in a position to be able to command carriage exercise, and the sort of carriage needed, the child, instead of being entirely confined to bed, may be carried into the open air and placed in a proper recumbent or semi-recumbent position—or if at the seaside a boat may be available. However it may be most easily and beneficially managed, some stay in the open air should be obtained—but let me again repeat, with entire rest of the joint. When the monetary position of the patient places these conveniences within reach, the prognosis of strumous disease is far more favorable than when they are unobtainable.

After an interval a certain arrest of the proliferating swelling takes place, and now a more stringent pressure should be used—a complete enveloping of the joint in strips of strong strapping plaster very tightly applied—swelling of the limb below being prevented by bandages—rubbing and other means also must be resorted to, of which more must be said in the sequel.

If, however, the case be of a sort in which no traumatism—no definite beginning in an attack of pain—in which, perhaps, the mother or nurse has observed a swelling before the child complains, before he even limps—if, on examination, this tumefaction be found doughy, soft with false fluctuation and with distended surface veins—if the child, although, perhaps, amply fed, be ill-nourished—if he bear the evident marks of a strumous diathesis, the mere rest treatment, as above described, will have but little effect, and we must add to it other means. It is true that in a certain proportion of such cases all remedies will fail to cure the malady, but often the disease may be arrested; and I need not say that, if local remedies are to be used, removable apparatus only are permissible.

The treatment by blisters has been differently estimated at different times and by different people; this, in part, depends on the choice of case and on the mode of use. To apply such remedy immediately over a superficial joint in a state of strumous disease is a mistake; to prolong the application until the whole surface is vesicated a greater error; to keep the blister open with irritants is a barbarism. If it be applied, especially if kept on a long time, over a superficial joint, like the knee, it is likely to do harm, because the mere thickness of the skin divides the remedy from the disease, and the former is likely to overstep that limitation and augment the disease itself. The value of a counter-irritant is almost, if not entirely, limited to the interval during which redness of the skin lasts, and it nearly ceases when vesication is complete. This impression should be conveyed through the nerves (we all know how useful blisters are in some forms of neuralgia and of pleuritis); hence, in each joint the counter-irritation should be applied over the course of the nerves, which chiefly give supply to the joint—first, over one, then, as the skin recovers, over another, and so on till we recommence at the beginning of the series. Other modes of exciting counter-action are the strong nitrate of silver solution painted on the joint itself every other day, or sometimes every day. The action produced by this

drug extends but very little way from the place of application, does not, therefore, easily pass inward to the inflamed tissue itself; it is different with iodine, the inflammatory result of this chemical spreads deep, hence its stronger solutions should be used like cantharides.

The inflammatory hyperplasia of strumous synovitis comes, after some time, to an end, and then there is in most cases a phase of inaction (p. 111), during which the embryonic tissue seems undecided whether to take the downward route to degenerative or the upward to formative acts. The surgeon's aim, I must more strongly accentuate it, the surgeon's duty is to detect this phase, and to insist on taking the ruling part in the decision. When tumefaction ceases to increase, the special spots of pain must be questioned, and the other symptoms be thoroughly examined. If the signs of active inflammation have ceased, the real state of the new tissues is one of sluggishness; any action must be better than mere idle falling to decay. Under such circumstances, all those manœuvres known under the name of "shampoo" are often followed by even unexpectedly good results; especially should those acts which compress the tissues and direct their superabundance in the course of the venous or lymphatic currents be employed; and these may be used in the commencement for five minutes once in the day, then twice in the day, and then the time of each occasion may be gradually prolonged.[1]

With this treatment firm compression of the joint should be combined, the most convenient means being the elastic webbing bandage, which, in the intervals of the shampoo, is to be applied with cautious tightness; over it the splint or double leather case should be adapted.

Of passive movement, and its possible applicability in this stage, I shall have to speak immediately.

Another treatment, of which I think very highly, is the injection into the diseased tissue of iodine solutions.[2] I first used these methods in 1872, and have very frequently employed them since with, in many cases, much advantage. The strength of the solution may begin with half a drachm of tincture of iodine to seven and a half drachms of water, and may gradually increase to two or even three drachms in the ounce. A syringe, holding about half an ounce, fitting into a tubular needle, rather longer than the usual hypodermic needle, and with lateral as well as terminal perforations, may be used. The syringe being filled, the needle is adapted to its nozzle, air excluded, and then the surgeon passes, a little beyond the first lateral perforation, his needle into the softest part of the tissue, but avoids entering the cavity; the needle, therefore, should take an oblique course, thereby traversing as much tissue-substance as possible; a drachm, or a little less, may be injected in one spot, and the surgeon can, if he think well, select another on the opposite side of the joint; or, by directing the obliquity of the needle in a different course, inject more tissue from the same puncture. My *à priori* reasons for trying this method were a strong perception of the indolence of these tumefactions, and a desire to imitate in them the remedial measures so often used in sluggish ulcerations. When, for instance, such a sore neither spreads nor heals, but simply remains in the state of granulation, we excite it by stimuli and irritants to some form of action, which shall lead to cicatrization. The results of this deduction have by no means disappointed me, but, on the contrary, a great many cases thus treated have been led to a good issue, and I have never found

[1] See Mosengeil, Verhandl. d. Deutsch. Gesellsch. f. Chirurg., 4th Congress, 1875.
[2] See my paper in British Medical Journal, vol. ii., 1874, p. 489.

harm result. No pain beyond the mere needle prick is produced. Immediately after the injection, pressure and the splint should be reapplied. In a day or two, if the remedy be fulfilling its object, the parts over the injected spot will be found slightly harder, a little more condensed, and in the best cases even a little depressed, the fibrillating tissue having drawn the skin inward. The injection may be then repeated at intervals of three or four days in other parts of the circumference.[1] Iodine, however, is the best basis ; any variant, such as carbolic acid or nitrate of silver, if used at all, should be only exceptional. Iodine has a greater power of disseminating itself widely among the granulation-cells than any other fluid, with which I have experimented, moreover it has no tendency to excite suppuration, but rather induration and thickening ; it is these qualities which make it of special value.

When a certain definite consolidation has been obtained, and on that account, or because sufficient activity of the tissues has been produced, pressure becomes extremely valuable, especially if combined with some slow rubefacient or irritant action on the skin. Of course any bearable amount of pressure can be attained by means of the elastic bandage, but it is apt in a little while to slip, to become loose, or to be loosened ; hence an adhesive form of plaster is preferable. The joint should be strapped with strips of such material firmly and strongly in the manner already described.

Passive movement is also, in a certain number of these cases, remedial ; we must be quite sure that inflammation has ceased, that the period of inaction has arrived ; if that point be clearly ascertained, such motion of the joint, during shampooing, is to be employed for a short time daily, and then, as in these other recommendations, the splint is to be replaced. The difficulty lies in getting all this properly done, and not overdone ; the patient should be visited at not long intervals, and the measure of the joint taken on each occasion ; if it decrease, good is being obtained, if it increase, the treatment has been premature or too energetic ; absolute identity of size shows, at all events, that no fresh inflammation has been lighted up, and is a hopeful sign, since the tissue, which is not proliferating, will, under these circumstances, surely cicatrize.

The maintenance of the general health is a great essential, and if the disease be in the lower limb continuance of the entire rest-treatment in bed is extremely likely to frustrate any efforts we may make in this direction. A child with a shoulder- or elbow-joint disease may go about, and, preserv-

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[1] It is a singular coincidence, that while I was trying the injection of these fluids, not as remedies for inflammation but as exciters of action, Dr. Hüter, of Greifswald, was beginning to use an injection of carbolic acid as an antiphlogistic. He published his practice, and the theory on which it was founded also, like me, in 1874; and in his work on Joint Diseases, second edition, 1st part, p. 206, states that his "New method is founded on the experience that the local application of aqueous solutions of carbolic acid to inflamed wounds renders "most valuable antiphlogistic results;" hence he derived the idea that the same antiphlogism would follow moistening internal tissues with the same material. In his journal, the Zeitschrift für Chirurgie, Bd. iv., p. 308, is a description of the instrument he uses, and of very brilliant results. I have, led by this idea, given these injections a full trial, but am sorry not to be able to confirm Dr. Hüter in his estimate of their value, finding no antiphlogistic virtue in carbolic acid injections. Nor does it seem to me that the reasoning is well founded, since that material applied to a wound is not an antiphlogistic; it may render innocuous certain other matters which if left alone would excite inflammation, and hence in a secondary and indirect way will be adverse to certain forms of such action; but its direct effect is irritating, tending rather to produce inflammation, and the noxious matters against which it guards open wounds, are not to be found in the substance of tissues unexposed to the air.

ing a good general condition, is more likely to carry the joint disease to a favorable end than one who, suffering from knee disease, is kept in bed. A device by Mr. Thomas enables us, in a certain degree, to obviate this difficulty; viz., the child is to have a high shoe or a patten or an ordinary high boot on the sound foot, and a pair of crutches. The diseased limb, properly supported by some form of splint above described, swings free of the ground and bears no weight; the child taking exercise—not, it is true, in a very pleasant way—and getting out of doors, maintains a bodily health, in which suppurations are less likely to supervene than when the general condition is depressed by confinement. The patient should not be allowed out of sight and reach till he has perfectly learnt to use the crutches, only a certain amount of exercise is to be granted, and he must be constantly watched, lest he get into some trouble by a fall. All these points create some difficulties; and another obstacle, not unfrequently among the well-conditioned, is a great dislike to seeing one of their children going about in the manner described. In making his choice between this form of treatment and entire rest in bed, the surgeon will have to exercise all the care, acumen, and judgment that he possesses. One thing I should like to add, if he have used these qualities, and have duly watched results, and nevertheless the joint fall into severe disease, he need not of necessity consider that he has been wrong; although the parents are pretty sure to do so; a certain proportion of these cases are founded on too pronounced a constitutional evil to do otherwise than ill.

The Second Stage requires, as long as its chief symptom and distress, viz., starting pains, continue, entire rest in bed. As the condition is implication of the cartilage and of the bone, I would refer the reader to the chapter on Strumous Ostitis for a more detailed account of its management. In this place it appears only necessary to refer to certain points in which the two differ. In this stage extension of the joint is often of great advantage, especially at night when the starting pains are most severe, the pulley and weight may be used for joints of the lower limb, more especially of the hip and knee; such treatment for the shoulder and elbow is more difficult of application, and is less important, nor are, as we have seen, starting pains as severe. Splintage and utter rest are of course necessary. If in spite of this the evil continue to increase, we have a resource to be sparingly employed, viz., the actual cautery. This remedy, which at the first mention seems cruel, is in properly selected cases very merciful. I have seen patients who have had no uninterrupted sleep for weeks, rest quite placidly at night after this appliance; also children, who previously could scarcely allow any one to approach the bed, laughing and playing directly afterward. Indeed, the immediate effect of the hot iron is to allay these pains in a very singular manner, and this remission lasts for from three days to ten days, and then in some cases the trouble sets in again, unless remedies, to be taken in the meantime, have had a beneficial effect, or unless repetition be possible.[1] The iron should be at a white heat, and a single line, not too long, be drawn with gentle pressure and rather slowly in the axis of the limb. It is well to let the line occupy as small a space as may be considered can have any effect. Afterward the part should simply be dusted with oxide of zinc powder and covered by a thin layer of cotton-wool, and when separation of the slough begins, healing should be procured as quickly as possible; the suppuration appears not to be the beneficial agent, but the actual skin irritation. The same thing may be said of caustic issues, etc.,

[1] For the method of using the iron, see Chapter XI.

a long-standing suppurating sore is undesirable. If starting pains be combined with malposture, they may at first increase when the position is rectified, since the muscles (flexors) are thereby rendered more tense; hence, section of one, or even of more, tendons may be desirable: this remark applies especially to the knee and to the ham-strings, but as a rule bromide of potassium has great influence in obviating the effect of tension after reposition.

As to internal remedies; opium or morphia in sufficient doses, when absolutely necessary, will procure sleep; but those drugs do not appear to have much beneficial influence on the spasmodic muscular twitching. I have more than once seen, and oftener been assured by the nurse, that even while the patient was slumbering the limb started. In some cases moderate doses of strychnia have considerable effect, and in a greater number bromide of potassium exercises much influence over this symptom. I prefer trusting to one or the other of these alternately; to give opium for pain which must be expected to continue a long time is a doubtful proceeding; the drug may, however, be reserved for an occasional emergency.

Here, and in concluding this account of different modes of treatment in the two first stages of this malady, I must state that no amount of granulating or fungating disease, as yet not suppurating, can in my opinion justify removal of the joint, either by excision or amputation; as long as the new tissue is simply a tissue, not a bag of pus, nor a collection of abscesses, even though the cartilages may have given way, so long may we still entertain hopes of preserving the joint, anchylosed perhaps, either truly or falsely. Widespread suppuration and caries put the case on a different footing, but mere strumous enlargement, with one or even two small abscesses, does not warrant either of the above radical measures.

Third Stage.—The degenerating or suppurative aspect of the third stage requires management which will differ considerably, according as those actions are rapid or slow, widespread or limited in extent—in either event we have abscess to deal with, intra-articular, peri-articular, or adjacent. If the pus-formation, either by secretion from, or decadency of the granulation-tissue, be so rapid as to produce tension, we must, whether this be intra- or peri-articular, take some means of relief. The less severe procedure, and that which I advise in any case, not too greatly depressed or exhausted, is to evacuate the cavity under pressure. The aspirator does not answer here, the flocculi being too many and too large to pass through the needle; but if an elastic bandage be put rather tightly round the joint, leaving a small interval where the pus seems most superficial, and if through this a narrow-bladed straight bistoury be passed, the pus will readily flow, more especially if the flat of the blade be deftly used to hold the wound agape. This should of course be done under the spray, and the wound is to be dressed antiseptically; whether or no a drainage-tube be passed in must depend on the surgeon's opinion concerning the entire evacuation or the probable rapid fresh formation of purulent fluid. When the cavity is quite empty and the little wound dressed, strong pressure should be employed. Hyperdistention by injecting the cavity with a three per cent. solution of carbolic acid, by means of a ten-ounce syringe through an india-rubber tube (a gum-elastic catheter answers best), has proved in my hands beneficial, especially if the abscess be intra-articular.

If while the patient's health is rather depressed, degenerative actions be pretty rapid and widespread, it is often better to make a free incision into the abscess in as depending a part as possible; if this be done under the spray no feverish reaction results; and one may even introduce a properly

prepared (antiseptic) finger into the wound and remove those parts of the tissues, which, being soft enough to come away easily, are evidently degenerating. Such an opened abscess is to be treated without much reference to its being in a joint (save the splintage or extension), which has abrogated its peculiarities as a highly irritable organ; namely, it is to be allowed to heal by granulation from the depths, and any application likely to promote this object, stimulant or astringent, may be used. I have on several occasions seen the best results follow such treatment of joints, which must otherwise have been removed. Some surgeons, when they have opened up a joint thus diseased, use a rather strong application, sulphuric acid diluted with an equal bulk, or twice the bulk of water. The method is rather too heroic, and although a certain number of patients have got well after this treatment, a good many have succumbed. Simple opening up of the cavity, or cavities, answers all purposes, unless there be deep abscess in the bone, which is usually the result, not of synovitis but of ostitis, and which acid used as above will not cure.

Adjacent abscesses, more especially those that run along the bone, are very difficult to treat; if they communicate, as they occasionally do, with other abscesses about the joint, the limb should be bandaged, a pad being placed over the track of the abscess, so as to press out the pus and prevent the further spread upward of the morbid action. If the abscess do not communicate, its lower or upper end should be opened, according as it is in the upper or lower segment; it should then be padded and bandaged toward the opening. Hyperdistention, with either iodine or carbolic acid, is sometimes useful.

In a certain number of cases, in spite of all skill, the disease continues to get worse; bone débris and portions of sloughed granulation, or ligament-tissue, come away with the discharge, the joint is evidently destroyed, and the question arises whether or no being retained its disease will destroy the patient. My experience at two institutions for cripples shows that patients may get well after an almost incredible amount of joint disease; but I do not see at those places the numbers who do *not* get well. Our treatment too in hospital and in private practice cannot be quite similar; in the former, time is a very considerable factor, while wealthier people can afford to lie by, or let a child lie by, for three, five, or even more years, in preference to undergoing an operation. Yet, occasionally, in both classes of practice, signs after a time arise that the choice lies between loss of joint or of life. These are fully discussed in the sequel.

The other phase of the third stage, viz., repair, may supervene at any time, either after suppuration has produced considerable changes, or before any such action has commenced. If no abscess exist, the diminution in size of the swelling, and reappearance of normal bony prominences, should warn us not to permit the joint to become unnecessarily stiff. I am certain that many a stiffened joint ought to be avoided. Rubbing, passive movement, etc. (see p. 124), may be safely employed with due caution, while consolidation is hastened by pressure. The same may be said when, after abscess, the sinus mouths are healing, but even more circumspection is then required. Again, if certain events threaten true anchylosis, more vigorous movement may be used. The surgeon is to discriminate between such cases whose best termination is true anchylosis, and such as are susceptible of something better. At all events, let him watch that the joint may lie in the most convenient posture, if it is to be stiff; or may enjoy such restricted motion, as can be retained, in the most advantageous part of the normal arc.

Case XXXII.—Miss W., aged five, was sent to me on February, 1878, by Mr. Marsack of Tunbridge Wells. She was a child of rather strumous aspect, and of marked strumous descent. The cause of her coming was an affection of the right knee, which was observed two months previously to have become swollen. About three weeks after this had been noticed, a slight limp began, and some expression of pain was elicited. These latter symptoms grew worse, and at the above date the child was brought to me.

I found the knee markedly swollen, rounded, shapeless, soft. In walking, a decided limp occurred, and the child gave evidence of pain. The following measurements were taken:

	Sound knee.	Diseased knee.
Above patella	$8\frac{3}{4}$	$9\frac{1}{2}$
Across "	$9\frac{1}{2}$	10
Below "	$8\frac{1}{2}$	$8\frac{3}{4}$

I recommended a double leather case, painting the joint freely with nitrate of silver lotion, iron and iodine.

In two months the joint was of much the same size, but pain in the place of election was pretty strongly marked. The limb was placed in plaster-of-Paris, and the child under Mr. Marsack's superintendence evidently improved. After ten weeks that gentleman removed the plaster-bandage. He wrote to me that, although the joint was certainly better, it had not so far progressed as to induce him to change the form of application; therefore on the next day, *i.e.*, in the beginning of July, he again put on a plaster-band, and the child went to the seaside.

October 7th.—I saw Miss W. again. Mr. Marsack agreed with me that the joint was now sufficiently free of inflammation to permit of some passive movement and rubbing. Accordingly, a single leather splint was adapted on the outside of the limb. This was to be removed night and morning, the limb moved and rubbed for ten minutes, and then the splint reapplied. Gradually the time of rubbing, etc., was to be increased, and after a period, which Mr. Marsack would indicate, some walking with the splint on the limb might be allowed.

January 6, 1879.—The joint had almost entirely regained its form, and the movements were but very slightly restricted. She was allowed to walk a little without the splint, rubbing was to be continued, and passive movement of the leg to be carried out. At night splint to be reapplied.

April.—The knee was perfectly well.

In cases seen later a persevering course of treatment may effect much. Fortunately in the following the suppurative action was not deep, neither was it general, and pressure succeeded in consolidating the tissues.

Case XXXIII.—John ——, aged seven, a light-haired, pale, strumous boy, was brought to me by Mr. Watkins, jun., of Chandos Street, April 2, 1860, with a strumous inflammation of the ankle-joint. This complaint was of three years' duration, and appears to have been brought on by an injury inflicted by a large, heavy woman, in thick boots, having stepped back upon the child's foot; at all events, he has not been able to walk since that accident, and the ankle has been gradually swelling more and more. The difficulty of diagnosis is increased by some amount of malformation, so that the sound joint even looks a little distorted; the internal malleolus is very large, and the tibia, from a little above the joint, slopes outward and be-

comes very small; the axis of the leg is thus directed inward, and that of the foot outward.

The diseased ankle, however, was very much enlarged, as may be seen by an examination of Fig. 15; the tumor was soft and pulpy and extended in a smooth, even manner around the whole joint; was most marked at the back, but nevertheless was very considerable under and around the malleoli, also, in front, concealing the markings of the extensor tendons; the rest of the foot was thin, and the limb above the affected joint was wasted, showing in strong relief the puffy, ill-conditioned enlargement, at the back of which there was a red, inflamed spot where pus had formed. The difficulty of diagnosis referred to consisted in the deformity and large size of the internal malleolus, which much militated against any certain judgment as to whether or not the bone was affected. Finding, however, that moderate

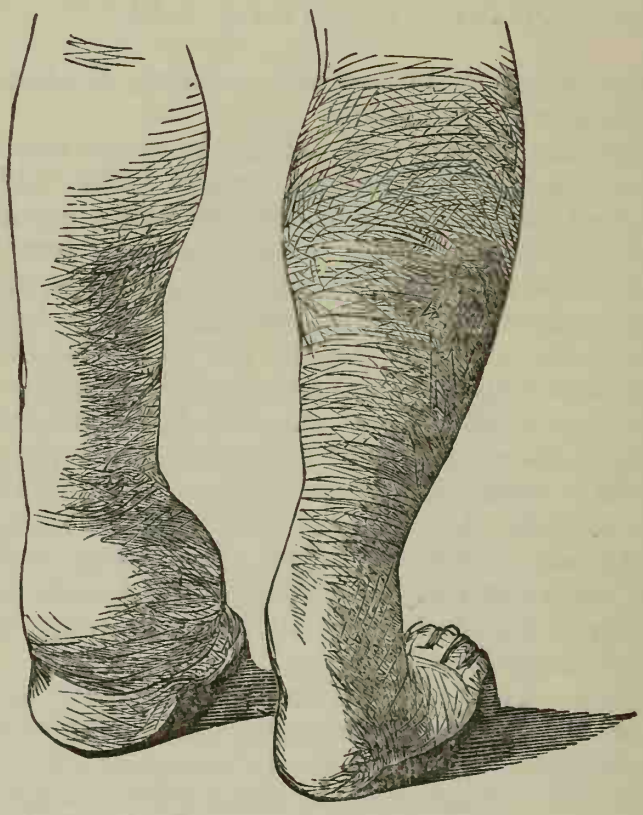

FIG. 15.—Strumous synovitis of ankle.

pressure on the bone produced no pain, and that although misshapen, it was as near as could be judged of the same shape as the other, I was pretty confident that the bone was free of disease.

April 2d.—A puncture was made where the skin over the suppurated part seemed thinnest, *i.e.*, over the Achilles tendon; a bandage was then applied, strongly compressing the tumor, but leaving the wound uncovered, and he was ordered to take a drachm of cod-liver oil, with iodide of iron, thrice in the day.

April 6th.—I saw the child again, and Mr. Watkins agreed with my idea that, the disease being a strumous inflammation in the sluggish stage, pressure fairly applied offered us the best chance of securing the absorption or fibrification of the morbid growth; therefore the foot and ankle were tightly and smoothly strapped, after Scott's method, with the resin plaster, leaving the open wound uncovered, and he was ordered to continue the cod-liver oil.

April 13th.—The strapping having become loose it was removed; the swelling was considerably decreased.

May 25th.—Mr. Watkins continued to attend this patient since the last date, carefully and skilfully carrying out the plan of treatment which had been laid down; the child's ankle was much reduced in size; there was no pain on pressing the tumor, nor the bone, nor on pressing the joint-surfaces together; the limb was again strapped; pads being necessary under the malleoli.

June 9th.—Still going on well as far as the ankle was concerned; the tumefaction diminishing, and there was no pain; the cod-liver oil no longer agreed; it seemed to diminish appetite; the weather was getting warm; he was ordered to try cold bathing in the morning, if he remained chilly after it to use it tepid at first; to take three grains of the ammonio-citrate of iron; the ankle was again strapped.

July 3d.—Has been under the care of Mr. Watkins; the same plan of treatment was carried out, and with such success that the tumefaction had greatly decreased, indeed, the ankle was very nearly the same size as the other; he could bear pressure on the bottom of the foot as strongly as I could produce it with my hand, and this did not give him any pain; but I could not persuade him to put any weight on it in walking. The cold bath had not been used; he looked pale and worn, but his appetite was very much better; the ankle was again strapped with pads under the malleoli; the cold bath was insisted on.

August 13th.—The boy was brought to me twice since the last date; the ankle was not at all painful; the wound at the back had healed, but the boy was so nervous that it was very difficult to make him put the heel properly to the ground, although I could, without giving pain, press the foot upward very firmly, forcing the articular surfaces together more strongly than his weight would do.

Shampooing and cold douche; motion passive and active.

I saw this patient on September 24th; his leg was still thin and weak, prevented his walking without support, but the joint was perfectly sound and the limb was gaining strength every day.

Case XXXIV.—I was requested to see Miss F. B., aged seven, on May 3, 1877, with a strumous disease of the knee, which had lasted just over ten months. The disease began by swelling, which at first was painless and caused no limp. After a time some lameness set in. By advice it was painted with iodine, and then poulticed; a straight, wooden, flat splint was bandaged on the back of the limb; but the little girl was rather spoiled and indocile, while the gravity of the case was, I fear, hardly recognized. Meanwhile lameness increased, as also did pain; the child was kept to bed; the same splint was kept on till two days ago, when the child declined to wear it longer; she was in great pain, and her sufferings increased. During the night of May 2d she hardly slept, but kept crying and even shrieking with pain.

On the morning of May 3d, I found her propped in bed with pillows, worn-looking and frightened, begging me not to touch her knee, and grasping the lower part of the thigh with both hands. The joint was flexed to a very acute angle, swollen, rounded, and shapeless. I could find no suppuration, but the examination was most unsatisfactory. I obtained permission to have chloroform administered, and during the afternoon, under its influence, the limb was straightened without the least force, and bandaged upon a MacIntyre splint. Examination of the limb showed a very soft enlargement, completely concealing the form of the bones. There was pseudo-

fluctuation at almost every point of the enlargement, but I convinced myself that no pus had formed anywhere sufficiently near to be detected.

May 4th.—She was very much easier, when she awoke from narcosis, and slept soundly until about 4 A.M., when she complained of pain at the back of the knee and thigh (tension of ham-strings); seven grains of bromide of potass, prescribed for this event, calmed her, and she slept till late. On my visit I found her comfortable. Painting with nitrate of silver solution, eighty grains to the ounce, night and morning, was ordered, with directions to recur to the bromide if pain should return.

May 19th.—The paint had to be twice intermitted; the limb was painless; but two spots of tenderness were detectable—one at its usual seat, the other over the outer tibial tuberosity. The skin was still rather irritated, A layer of wadding was placed over the joint, and tight strapping applied; limb below bandaged.

June 2d.—Strapping removed; joint smaller—but the false tissue still soft; injected in two places with tincture of iodine and water, forty minims to the ounce; this injection (afterward increased in strength) was employed twice a week for three weeks, at the end of which period the knee was considerably smaller and much harder. Pressure with elastic bandage was then resorted to, and for a fortnight the injections discontinued.

July 6th.—The knee slowly decreasing in size; injections resumed, continued weekly for a month; one and a half drachm to the ounce. A double leather splint was moulded on over the elastic band. On the 10th she was allowed to get up; on the 14th she took a drive with the limb on a pillow.

By slow degrees the joint improved; she went to the seaside at the end of August, but with injunctions not to put her foot to the ground. She had crutches, and moved about a good deal—walking and driving.

October 2d.—The joint measured the same size as the other, but it looked larger on account of shrivelling of the thigh and leg; the arc of movement considerably restricted. Passive movement and rubbing; then resumption of the splint; afterward swinging soon gave greater freedom.

At the beginning of the year 1878 the limb could be bent to a right angle—she could kneel. The joint measured, above the patella, $\frac{3}{8}$ inch less than the other. In June, 1878, when I again saw this patient, it was difficult to find any remains of disease, which were inability to get the knee perfectly straight, and to bend it till the heel touched the buttock, which the other could do.

Case XXXV.—I was asked by Mrs. T. to see her daughter, aged seventeen, September 30, 1859, with a diseased knee of four years' standing. She has dark long hair; a white transparent skin; very white conjunctivæ, long dark lashes. Her health was a good deal broken by long confinement.

At school, rather more than four years ago, her knee became painful; she may have hurt it, as she was very fond of running and other exercise, but does not remember it. When the knee became painful it swelled. She remained at school about three weeks, and then was sent home. A pasteboard splint was applied to the leg and the joint was blistered; had two issues, one after another, and the knee got so much better that she could return to school, but had always to wear the splint; could walk with, and after a time without a stick. Eight months ago she fell down two or three steps and hurt her knee very much; it swelled again, slowly, and an abscess burst at the inner side just below the head of the tibia; a little afterward she had starting-pains at night, and a week or so later these occurred also in the daytime, and they continued to do so. She desired nothing so much as that these should be stopped.

There was a rounded swelling, without definition of edge, at the knee; the mouth of the sinus still open; marks of issues, one on inside, one on outside of knee; the joint was tender and she had starting-pains; the joint could be flexed a little without causing any severe pain or producing any grating, but it could not be straightened; it was in very fair position, but rather too much bent. Her mother had taken up residence in town, having come from ——shire.

October 3d.—The long-continued starting-pains, showing that the cartilages were undergoing ulceration, would not allow us to hope a restoration beyond false anchylosis; the first object was to stop these pains; divided the flexor tendon with long tenotomy knife, and fastened a Liston's splint at back of the limb with well-padded straps and bandage; to have at bedtime half a glass of sherry with fifteen drops of laudanum. Slept better; had one or two little starts toward morning.

October 7th.—Had less starting-pains since the first night; had taken no opium since then, but had continued the sherry; thought it produced acidity; did not like wine. Ordered to take two tablespoonfuls of the mistura ferri composita three times a day. Cold water to be applied.

I took the limb off the splint, and by manipulations got it straighter and put it on the splint again.

October 12th.—Every other day the screw has been turned half round; the joint was nearly straight enough; strapped the knee, leaving the mouth of the sinus uncovered; to continue turning the screw in the same way.

October 19th.—A letter informed me on the 17th that the lady thought her daughter's knee was as nearly straight as I had desired it to be made, and there was a little pain in it; I happened not to be able to go till to-day; the pain was at the back of the joint, and had nearly gone off; the strapping had quite driven away the slight recurrence of starting. Ordered a leather splint for the outside and inside of the limb; strapped the knee still more tightly; to leave off the night draught.

October 28th.—The splints were applied and the knee felt very comfortable; she may now get up and move about on crutches.

November 7th.—Had been going on much the same; the swelling was very much reduced and was harder; there was still a slight amount of tenderness, particularly over the inner condyle of femur: to continue in the same manner. The mouth of the sinus nearly closed; hardly discharged; put in a shred of lint to prevent too early healing.

November 11th.—Was sent for; the discharge from the sinus had increased, and the startings had returned as bad as before; proposed the cautery and agreed to go next day and use it.

November 12th.—Chloroform administered; two lines of cautery four inches long, one on each side of joint; Liston's splint again; repeat night-draught.

November 19th.—Had hardly any pain on recovering from the chloroform; the startings entirely ceased when I saw her the day after.—The eschars separating: to dress the lines with zinc dressing, tightly bandaged.

Ordered to take of cod-liver oil one teaspoonful and two grains of quinine thrice a day.

November 29th.—The starting-pains had not recurred; the lines of ulcer from the caustic were beginning to contract; the granulations were small and pointed.

December 12th.—The caustic lines very nearly healed; joint strapped

and leather splints reapplied. As it was probable that want of care, in bearing too much weight on the limb, caused the last relapse, I have not allowed her yet to get off a sofa-bed which she used.

December 22d.—At this date permitted her to get up and go about with crutches, but she was to use a stirrup for the foot, fastened to the waist by a band of the proper length to keep the foot from the ground; there is now hardly any, if any, tenderness over the inner condyle, the sinus has healed.

January 31, 1860.—I have seen this patient once or twice; her health was much improved and she had gained flesh; there was, absolutely, no tenderness, and the joint was as nearly as possible the same size as the other; the patella could just be moved, latterly, by grasping it in the fingers, without pain; a slight crepitation, not bony; produced very slight passive motion in the joint without pain; showed her mother how to move the limb, and directed her to do it, so as not to cause pain, every morning; the strapping, also, was discontinued, and the joint to be shampooed, rubbed with oil, and bathed with hot water; the splint to be reapplied after these manœuvres; to leave off the stirrup.

March 3d.—Have seen this patient three times; the limb had more mobility and was not tender; she put the toes to the ground in walking, and bore a little weight on them; the joint was anchylosed (false anchylosis); passive motion to be used with a little more energy.

This young lady was at this time able to bend the limb and straighten it again voluntarily, to a fair degree; she walked with a stick or umbrella by means of a high-heeled shoe; more might be done toward getting a flexible joint, but she was rather unwilling to have any further attempt, at all events for the present.

Case XXXVI.—Daniel Hogan, aged thirty, a dark-complexioned man, rather above middle height, young-looking, a machineman at a printer's, came to me March 20, 1860, with a bad elbow.

About fifteen years ago he twisted the left arm in some game; it was painful, and in a few days swelled; he went to King's College, they applied blisters and iodine, the swelling at the inner side increased and it was lanced; some pus flowed. Before the skin was well, however, he went to Mr. Verral, who put on a splint; and then to St. Bartholomew's under Mr. Skey, who leeched it, and in about a fortnight lanced an abscess which appeared at inner side of upper third of forearm. All this took place in about a year or eighteen months; motion of the arm was painful, but I could not make out whether or not the inflammation was in the joint; at all events, he got so well that for the last fifteen years he had been machineman at a large printing-office, having frequently to lift heavy weights, as a form full of type, and, owing to a smash of the right hand, had used the left one most. Five months ago he had a swelling form at inner side, just below elbow, which got rapidly bigger, and in three weeks became very painful; he went to a medical man in the Waterloo-Bridge Road, who lanced it; the pain was a heavy and bursting pain. A month ago starting-pains came on.

March 20th.—The elbow-joint was much swollen; the swelling concealed the shape of the bones, was rounded and shapeless; the arm above thin; the tumefaction was evidently in and around the joint; it presented a false sense of fluctuation, which is characteristic of strumous synovitis; the skin was red at inner side and below elbow, where there was an opening discharging pus: a probe passed into it entered the joint, but did not come in contact with bare bone; he could not bear the slightest move-

ment or pressure of articular surfaces together. A gutta-percha splint was applied on the outside of the arm bent at more than a right angle; cod-liver oil and quinine administered internally.

April 12th.—Drawing made from elbow.

April 14th.—Nothing of importance to record; the arm had increased in size, and the starting-pains had become more marked; these pains prevented his sleeping at night; his looks had become worn and haggard; a a part near the inner condyle fluctuated so distinctly that I punctured it; no pus escaped; I put my little finger into the wound, felt soft jelly-tissue

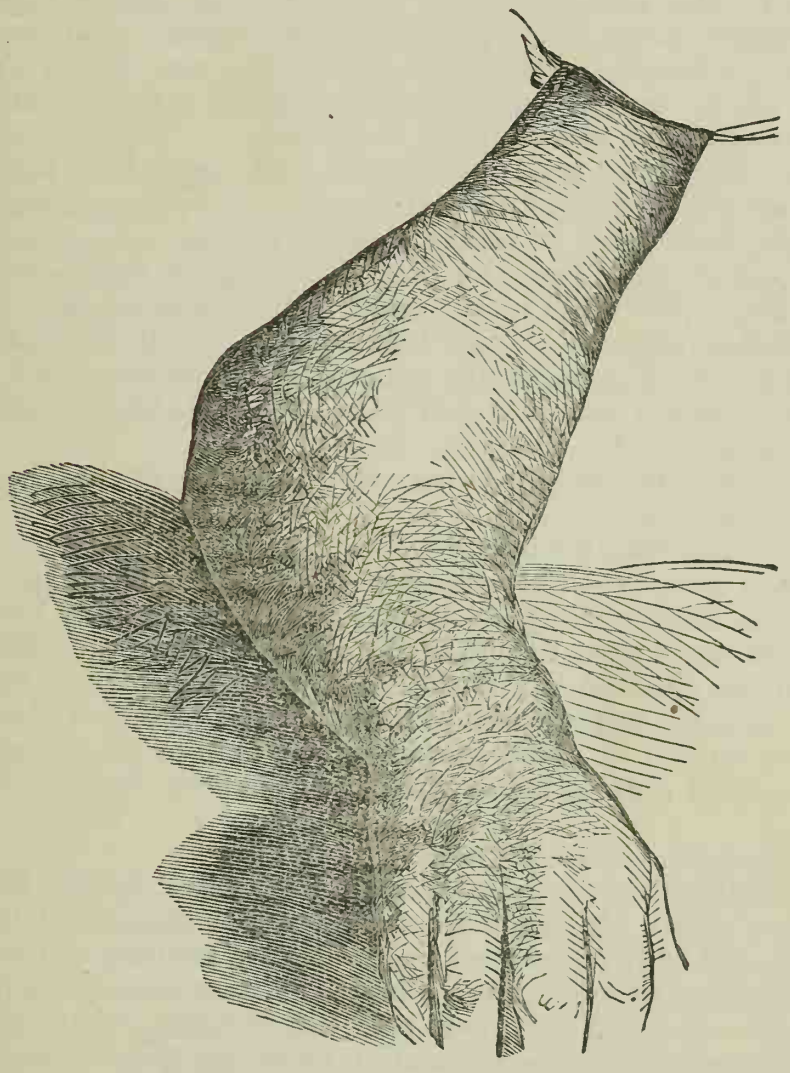

FIG. 16.—Strumous synovitis of elbow (advanced).

all round; a portion of this was extracted, examined beneath the microscope, nearly all the cells were found crowded with oil-globules; there were a great many free ones lying among the cells; to this formation was doubtless owing the fluctuation. It was explained to him that hardly the faintest hope existed of saving the joint, and he was advised to permit its removal: he wished to postpone this. With a view of trying to prevent the starting pain the joint was tightly strapped.

April 16th.—He had, after being strapped, a couple of the starting-pains, but none afterward; has slept very well. He told me to-day, for the first time, that for about a month past, whenever he leant in a certain

way upon the elbow, he had had a peculiar sensation, as though one bone slipped or glided over the other out of place.

April 30th.—He continued to be quite free from the starting-pains, and his looks had very much improved; the elbow was reduced in size and harder, but the last few days he complained of pain over the outer condyle; an abscess, very superficial but of large extent, was found; the skin was discolored and evidently separated from the subjacent tissues for some distance; it was freely incised; bled smartly, to stop which pressure was applied.

May 2d.—The part of skin which was previously blue and discolored had ulcerated; the sore was oval, about an inch and a quarter long by three quarters broad; the upper arm was swollen; strapping applied more tightly. I learnt, in the earlier part of the case, that this man was able to live pretty well, having, it appeared, saved a little money, but it was now exhausted; he was evidently badly fed.

May 9th.—The upper arm was swollen, with deep, hard tumefaction; again examined the limb carefully and passed a probe along sinus at inside arm; it struck bare bone, or rather seemed to pass into a chasm, with bare, rough, not crumbly bone, on every side. It was now pointed out to him that he had better make up his mind to the operation and come into the house for that purpose; to all this he agreed, but he could not be taken in; the following week the strapping was discontinued, but the starting-pains recurred with so much violence that his health began to suffer, and it was reapplied.

May 22d.—He came into the house, under my care, by the kind courtesy of Mr. Canton, and on

May 26th.—I excised the joint.[1]

Examination of Joint.—The synovial membrane was lined, and the subsynovial tissues thickened by remarkably soft, yellowish-jelly; on neither humerus, ulna, nor radius was there the slightest trace of cartilage; the cancelli upon the first and last of these bones lay bare, except that a soft, pulpy tissue seemed to grow out of them. The cancelli of the humerus were not bare, but a hole, about the size of the bulb of an ordinary probe, in the centre of the surface, led to a cavity in the bone that was filled with pus.

The man has done extremely well.

Case XXXVII.—On February 10, 1880, I was asked by Mr. Hird to see with him a boy under his care with strumous joint disease. I learnt that he had, at the end of 1879, first noticed a painless swelling of the joint, for which he could not account; after a fortnight movement became painful, and he limped. Rest relieved both pain and swelling, but they returned on resuming movement; since the end of November the swelling has been rapid. He had been in hospital since January 8th, and on February 19th, up to which time no marked change, but perhaps some gradual enlargement had taken place; he showed signs of failing health; temperature: morning 99°, evening 100.2°. This condition increased, the knee enlarged greatly, became very painful, starting-pains and loss of flesh set in. On the 8th, temperature, morning 98°, evening 101.5°.

When I saw him with my colleague, I found him very cachectic, pale, with small weak pulse, and marks of suffering in facial expression. The knee was very shapeless and large, a sense of fluctuation all over it, but most of this was false; some real sense of fluid was verified on the outer

[1] For the rest of this case see Excision.

side. The question being one of endeavoring by some more active surgery to save, or of removing the joint, we agreed to give him the benefit of wide and deep incisions.

February 12th.—Mr. Hird made a cut on each side into the cavity, from the inner; no pus came, but a quantity of jelly-like granulation-tissue lay agape in the wound. On the inner side there was an abscess which separated the skin for a large distance from the same sort of tissue, but not in the same state; portions of it broke away on examination with the finger, and little lumps, from the size of a pea to that of a walnut, came away. Another opening in the most dependent part of this abscess was practised. All this was done, and the boy was dressed antiseptically.

February 25th.—For five days the discharge was considerable, and the temperature still very uneven. After that improvement became manifest, and on the above date the suppuration was very slight, and the thermometer stood morning and evening at 99°.

March 4th.—Antiseptics discontinued; dressed with boracic lint.

April 3d.—Merely slow healing of the wounds to report; the knee at the above date was of course still enlarged, but the tumefaction was hard; slight movement only remained, the MacIntyre was taken off, and a gutta-percha splint substituted; he was to get up.

June 14th.—The boy has gone on very well indeed; at the above date the wounds had all healed, and the knee was barely swollen, but was healing by false anchylosis.

CHAPTER VI.

SUBACUTE RHEUMATIC SYNOVITIS.

Acute rheumatism leaves not unfrequently a chronic painful condition of joints that might be named as above ; but in such cases the peri-articular tissues and ligaments are more especially implicated, it is rather an arthritis than a synovitis, and the disease is poly-articular. The malady which in this chapter comes under our observation is, on the contrary, mon-articular, and, although it may sometimes be traced back to acute rheumatism, does not stand in direct continuity with such an attack, but begins some time afterward ; more usually it arises in a rheumatic habit through some accidental exposure, perhaps combined with traumatism, and occasionally, though rarely, has poly-arthritic prodromata. It is more usual among the richer than the poorer classes, and far more common at the knee than elsewhere. It has two forms very similar in their early, widely divergent in in their later, phases ; the one approaching common acute synovitis, of a dry or fibrinous character ; the other tending to the development of dendritic or hirsute growths, from the inner surface of the membrane, thus having resemblance to hydarthrus, or the production of false bodies. Although I have rarely seen either of these diseases as a direct sequel of acute rheumatism, yet, as they are certaintly part of the rheumatic diathesis, it will be well to consider the phenomena of that, at present little-understood condition.

Acute rheumatism is a systemic fever, therefore it lies, although parts of the body essentially surgical are affected, within the jurisdiction of the physician. Yet it is necessary that as surgeons we should, in order to elucidate the rheumatic form of joint disease, glance at the phenomena of the rheumatic fever, and elucidate, if not its pathology, at least its effects.

The order in which the symptoms of acute rheumatism occur is not always the same, but whatever it be they are generally preceded by a certain feeling of *malaise* and vague wandering pains in the limbs, such as are usual before the actual invasion of any febrile disease. After a certain period of this incubation there comes on a shivering fit, accompanied or followed by great pyrexia, indicated by a temperature of 100–103° Fahrenheit, acid perspirations, and by the whole train of symptoms constituting the perfect disease, a great part of which is pain and swelling in one or more joints. The affected articulations are very painful, enlarged, hot, red, and, when first swollen, fluctuating ; but the most remarkable feature of their condition is, that a joint thus suffering, and exquisitely painful, shall in a few hours lose these signs of inflammation, which are transferred to another and distant part.

A very important character of the malady is the tendency exhibited by internal and vital organs to assume an inflammatory condition, thus, the

peri- and endocardium, the cerebral meninges, the pleuræ, peritoneum,[1] become involved; moreover, in the larger number of instances the inflammation proceeds rapidly to the deposition of lymph, producing thickening adhesion, or consolidation, as the case may be.

After a time, less definite than in continued fevers, or in the exanthemata, this malady has a tendency to get well; this does not mean, however, that the patient gets well—for serious heart, or other mischief may have been produced—but that the pyrexia has a great tendency to decline and cease. The joints which were affected still remain for a few weeks painful, and enfeebled with stretched ligaments and relaxed membranes; sometimes with damaged cartilages, and restricted motion. The patient may, however, die of the fever,[2] that is apparently of the intensity, or the amount of the pyrogenous poison, of hyper-pyrexia, and singular to relate when this usually fatal rise of temperature (106° to 110°) takes place the hitherto exquisitely painful joints cease to be tender, and generally are less swollen.[3]

Thirty years ago, Dr. Todd, insisting with much eloquence on a theory primarily advanced by Dr. Prout, impressed generally on the profession the idea that the poison, producing these very remarkable phenomena, was lactic acid. Dr. Fuller followed the same course. In the first edition of this work (1860) I showed on what very faulty chemistry this idea was founded. At the present day the whole lactic acid theory is abandoned, I believe, by all pathologists; and indeed it is wiser to have no theory of the rheumatic poison. It may be said that we know as little of the poison of small-pox, measles, enteric fever, etc., but there is here a difference: each of these fevers is communicable from an infected person to a healthy one, each attack is the direct offspring of a previous illness—the malady being never generated *de novo*—there is evidently here something in the nature of organic or cell-germination. The germ or spore whose pullulation in the body produced the disease exhausts, in nearly all such maladies, the particular material on which it fed, so that an attack, say of scarlatina or small-pox, confers an immunity, is a safeguard against another attack.

Rheumatic fever is not the child of a previous rheumatic fever in another individual; it is generated each time *de novo* within the system of the sufferer. The tendency to it is in a considerable degree hereditary; one attack, far from giving a certain immunity for the future, appears to leave behind it a predilection to renewed onsets of the disease. Proneness to acute rheumatism is a youthful condition; the disease is rare as a first attack in a person over forty. All these peculiarities lead to the conclusion that faulty assimilation (primary or secondary) has produced, or that inefficient excretion has failed to eliminate a *materies morbi*, whose rapid accumulation in the blood sets up the train of phenomena above briefly sketched, and whose slower imbibition gives rise to chronic articular rheumatism. Yet what that material is remains one of nature's secrets, and herein the disease differs essentially from another malady of similar generation—namely, gout, whose specific poison is so well known and so easily demonstrated.

Whatever the poison may be, it has, besides its pyrogenous qualities, the power of rendering the resultant inflammations very reluctant to end in

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[1] The serous membranes and vascular cavities originate, like the joints, in the mesoblast, see p. 15.

[2] The cardiac, pleuritic, or meningitic complication may of course prove fatal; such patients die of chest or head mischief respectively, not of the fever.

[3] The reader should consult Dr. Pollock's excellent and very readable Notes on Rheumatism.

suppuration, but very prone to terminate in fibrinous thickening with adhesions of opposed surfaces, as of pericardium or pleura, or at least roughness and fibrinous vegetation of those membranes.

Moreover, the inflammations have a quite remarkable attraction to fibrous tissues. Fasciæ, pericardium, pleuræ, are all examples of this kind of tissue, and are all especially open to rheumatic attacks: while post-mortem observation shows that the parts *around* joints, the subsynovial and ligamentous tissues, and the sheaths of tendons, are more often and more deeply affected by acute articular rheumatism than the synovial or bony tissues.[1] Moreover, although during acute rheumatism any considerable thickening of the synovial membrane is unusual, yet the increased fluid is often turbid, with cell-growth, and in no other inflammation are floating flocculi or fibrous concreta so largely and invariably found.

Chronic or subacute rheumatic synovitis differs from acute articular rheumatism in some important particulars besides mere severity. The malady may be a relic of an acute attack, or may be *ab initio* a chronic disease, without assignable local cause, or even may result from traumatism occurring in one of rheumatic diathesis.

This form of synovitis is generally mon-articular; but if it have originated in acute rheumatism, two or even more joints may be affected.[2] Occasionally, though rarely, a rheumatic synovitis of the primarily subacute variety affects two joints; but if the disease arise in traumatism, for instance in a sprain or bruise, one articulation only is diseased. An injury even, though slight, if it be followed by exposure to cold, may induce severe affection of this description. The malady is then wont to commence as an acute synovitis, in which pain is strongly marked in proportion to the comparatively slight swelling. After a time the fluid-effusion and fluctuation subside, leaving a peculiarly shaped, hard and painful tumefaction, which, to the great disappointment of both surgeon and patient, proves somewhat obstinate.

Inflammation is the same process, whatever its predisposing and immediate cause may be; cell-emigration and proliferation are of necessity in such condition; it is the after-history of the cell-progeny which locally differentiates one sort of disease from the other. In the form of synovitis which I have called strumous, the growth has but the very smallest tendency to form tissue, it remains simply as a mass of cells; in the rheumatic disease, the impulse is always to tissue-production. The inflammatory neoplasm remains but a very short time in the form of granulation, but quickly becomes a coarse and a rather hard fibrous structure.

The first acute and each subsequent attack of inflammation consist, as all inflammations of connective tissues do consist,[3] of plentiful granulation,

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[1] Dr. Todd (on Gout and Rheumatism, p. 134 et seq.) endeavored to show that the articular affections of acute rheumatism are not "true" or "ordinary" inflammation. In my first edition I refuted this view. At the present day such contradiction is hardly neeessary.

[2] I have seen three cases in which three, three and a half, and five months after the acute disease, two joints in the first two cases, three in the last were still affected with synovitis, much stiffened and often very painful; the last case might perhaps with propriety be termed a case of incomplete recovery; the young lady's heart was considerably damaged, and much debility remained; after some months she became better, and went by my advice to Kreuznach, deriving further advantage. In 1874, another attack of acute rheumatism occurring seven years after the primary one, proved fatal by severe cardiac complication and hyperpyrexia.

[3] See previous chapter, and my paper On Granulation as it Affects the Joints, in Beale's Archives, November, 1859.

i.e., growth of cells. In the rheumatic inflammations the tendency of this growth is always fibrogenous—organizing; hence the inflammatory product, or thickening, instead of remaining in the soft gelatinous stage of fungoid granulation, becomes a tough, firm membrane. Thus the tissue never reaches a rank luxuriousness of growth, since most of the cells, instead of generating new cells, become transformed into fibres, and those fibres contract. The inner surface of the synovial membrane is therefore hard; presents long, rounded undulations, which run in a direction round the joint, and are separated often by rather deep but narrow fissures; the color of the tissue is of a light red-brown, about the hue of calf leather. The dendritic growths of the villi encroaching on the cartilages are conspicuously absent; instead of them, thickened folds or waves of fibre-tissue overlie those parts which are out of contact with the opposite cartilage. The section is evidently fibrous, an appearance more easily visible when the tough tissue is torn asunder, not cut. This material occupies the place of the synovial membrane, that fine fabric having disappeared in the much coarser substance, which is formed around it and on its surface. The growth may be of variable thickness in different cases, indeed in different parts of the joint and in the same case. Thus, at the knee, it will be usually pretty well developed on each side of the ligamentum patellæ, will be thinner at the back, but in the subcrureal sac is formed into a dense hard cushion, which not uncommonly almost fills up that space, and sometimes does so altogether.

If a thin section of the material be made, and be placed, without much disturbance and no tearing, under the microscope, it will appear at first sight to consist entirely of fibre-cells, of fusiform oval and round cells, very closely packed together; a more minute examination will show that the oval and round cells are, except on the surface or new parts, small in number, and that the tissue also contains a great number of fibres, which cross each other in every direction, and give a strongly striated and cross-barred look to the section, at the edge of which the fibres, projecting beyond the limits, are very visible. On examining, instead of a section, a shred, which has been torn with needles, the fibres appear more or less separate, and may be seen to be long cell-fibres, in many of which the nuclei are still perfectly distinct. The loose oval and the few round cells have almost disappeared in the tearing, and uncover certain torn portions of a homogeneous membrane, which evidently, in its uninjured state, permeated the whole tissue—*Kittsubstanz.*

Some difference in these appearances will be observed, according as the examination is made upon a part, which has for some time been in a quiescent state, or upon one which has recently been inflamed; in the former, we shall find simply the elements of condensed areolar or of scar-tissue, in the latter event we find such parts softened and rarefied, permeated and infiltrated by a fresh production of round and ovoid cells. But even in the very act of inflammation, the new growth is much slower in proportion to its greater condensation than the exuberant increase of the fungating synovitis.

In all cases the joint contains a slightly increased amount of fluid, often rendered opalescent, or even milky by the admixture of white round cells. Many of these bodies are derived from the inner surface of the membrane, and also emigrate directly from its vessels; others emanate from the proliferating cartilage-cells. In most cases the joint fluid is very markedly mixed with fibrin, much of which coagulates into transparent jelly-like concreta, or if mingled with cells into white opaque flocculi, looking like

soaked pieces of floating cotton-wool. I have twice found the synovia very thick, almost gelatinous, only a little less viscous than that, which is evacuated by puncture from a chronic ganglion.

The ligaments present peculiar appearances, combined of thickening retraction and relaxation. The first is produced by an interstitial change in each fibre, whereby their flexibility is impaired; hence, where by position the points of insertion were approximated, the shortened ligament is unyielding; where separated, the lengthened tissue will not adapt itself to a new position. Hence considerable and painful stiffness is an early consequence of rheumatic synovitis.

I have but once found abscesses in the thickened peri-articular tissues, never in the sheaths of tendons, nor among the deep muscles. When the tendinous sheaths are affected, they are either distended with serous or synovia-like fluid, or, in older cases and a more chronic stage, are thickened and partly filled with fibrous material. This peculiarity of the rheumatic inflammation not to suppurate is a mere corollary of the law, that such an inflammation tends to fibrinate, for the cell cannot fulfil two destinies—the formation of the fibres and that of pus; and as in these cases they are employed in the production of tough compact tissue, they cannot at the same time generate the lowly organized and vegetative pus-cell.

The cartilages in their turn become inflamed, and exhibit in some parts a superabundant cell-growth, beginning at the free surface and ending in ulceration through the thickness of the structure: the ulcers thus formed are generally clothed at the bottom and sides with fibres, resulting from the splitting up of the hyaline substance. In other parts, and sometimes close to such an ulcer, a surface of polished bone will be found on a level with the rest of the cartilage, and therefore of course projecting beyond the articular osseous surface. There is no doubt that this bone is formed from the cartilage. I have never found such ossification of articular cartilage except in rheumatic disease, and it is another instance of the organizing tendency of that form of inflammation.

In other cases we find these structures lose their peculiar white opalescence or bluish appearance, and become of a lightish brown color, abnormally transparent, and at the same time very thin. This change is also due to an ossifying process, more evenly distributed; to one which, instead of being confined to a small spot here and there, is distributed over the whole or a great part of the articular surface of the bone, and causes a gradual encroachment of the osseous upon the cartilaginous structures. This mode of action is peculiar to the more chronic forms of the disease.

In more rapid cases, in which the ulceration of cartilage and the localized spots of ossification appear, it is not unfrequent to find parts of the cartilage with its articular lamella detached from the bone. In a case which was to me of extreme interest, all these three conditions were present. In other cases only the gradual thinning of the cartilage and some ulcers apparently old are found.

The bone is found nearly always condensed, *i.e.*, the walls of the cancelli thickened, and each cavity proportionally diminished in size, the whole therefore heavier and more solid (osteosclerosis). This is often strongly marked in the portion next the articular lamella, where the bone becomes much condensed. Besides this, the inflammation, as it spreads from the synovial, affects the fibrous tissues, viz., the periosteum, and others lying close to the bone; the inflammatory products which these throw out do not stop in the condition of granulations, nor do they suppurate, but advance rapidly to ossification, thus producing thickening, and, as much of

the new material is in irregular masses, the so-called osteophytes. Such growths are rare in strumous synovitis, and when they do occur are comparatively rather small and unimportant. In strumous ostitis they represent mere roughnesses, overlapping carious depressions. In rheumatic synovitis they take a more important place; yet do not attain that stalactite form of exuberant growth which is seen in arthritis deformans. Nevertheless, though small and generally conical, they are numerous, and frequently occupy a large extent of the surface, spreading to a considerable distance from the joint.

When the cartilages have become more or less destroyed or ossified, the bones of the joint begin to grow together, and in this process again the organizing character of the disease is manifest. When we look at a joint anchylosed by this form of synovitis we find that the junction is produced by considerable addition; generally the patella unites first to the outer condyle of the femur by an osseous stalk that seems to grow from both bones; then the femur and tibia become joined, also by processes, that arise from the two condyles of the former and articular surface of the latter; the inter-condyloid notch may remain open and form a foramen running through the middle of the conjoined bones. I believe this sort of junction to be assisted by adhesion to the bones and subsequent ossification of the menisci. This mode of bony anchylosis is very different to the strumous in which the two bones seem to sink into one another and to unite by fusion, instead of, as in these cases, being glued together by a thick lump of cement, which afterward becomes osseous.

There is a peculiar look about bones in this state; the natural elevations and depressions become exaggerated, the surface here and there roughened by an osteophyte; the openings, whereby little arterial twigs find their way into the inside of the spongy tissue, and which are normally very small, become plainly visible holes and grooves. In fact, the bones, without being very perceptibly increased in size, are exaggerated; as it were, caricatured. If a bone-end in the earlier phases of the disease be split, the cancellous structure appears throughout redder than natural, and the cancellar walls are hardly visible, being concealed by the bulging out of the enlarged contents. Afterward, patches of, and later still, all the section are found to be whiter and paler than the norm, from thickening of the lamellæ and consequent diminution of the cavities (osteo-sclerosis).[1] This osseous induration is generally most marked in the part that lies next the articular lamella. In some cases the cartilage and the articular lamella are here and there ulcerated through; the cavity of the ulcer is cut off from the rest of the articular facets by a ring of ossified cartilage: in other cases, and in other parts of the same case, a great portion of the deep surface of the cartilage is ossified; here the articular lamella has to a great degree lost its peculiarity of possessing no lacunæ with canaliculi; many of the black undeveloped bone-cells have thrown out such prolongations, and the structure assumes more and more the ordinary characteristic of bone-tissue; until, in the furthest advanced parts—those where the whole thickness of the articular cartilage is ossified—the structure becomes ordinary bone. The process is another instance of the organizing quality of this sort of inflammation. I have never found in any other form of synovitis the black corpuscles of the articular lamella throwing out canaliculi. If such an altered spot be, as sometimes happens, opposite a piece of the other bone as yet covered by cartilage, normal or ossified, and if motion be still allowed,

[1] For fuller particulars of this process see Chapter XI.

its surface becomes polished and smooth as glass; but if the spot be opposed to a part on the other bone similarly circumstanced, and motion be prevented, the two grow together by the formation of new bone between them. It thus occasionally happens that a patch of cartilage and a cavity lie in the midst of this sort of anchylosis; the cavity may contain opalescent or puriform fluid. I do not know how long such reliquiæ of the joint sac may persist.

The other form of rheumatic synovitis is less fibrogenous; it is characterized by less thickening, a greater amount of fluid effusion, and considerable enlargement of the synovial fringes. The thickening, though less in amount, is remarkably tough; its section is often of a bluish color like tendon—probably not throughout unless the case be very far advanced; but only in longer or shorter lines, according to the age of the disease; if such a joint be opened under water, a number of arborescent growths will be seen sprouting from certain parts of its inner surface. These are most abundant about the folds; indeed, wherever fringes normally exist, but in advanced conditions of disease, a few may spring from parts which are not naturally provided with these appendages, as for instance from the crucial ligaments of the knee. When the shoulder is the seat of disease, hypertrophied fringes have a remarkable predilection for the fold of membrane covering the biceps tendon. These growths are papillomatous in appearance, like that form of growth of the bladder or a cluster of villi from the chorion, but the ends of many of the twigs are bulbous, and some have a distinct knob containing a little bead of fibrous tissue, or of cartilage, sometimes only a cell or two of cartilage, surrounded by an obscurely fibrillated matrix. In these particulars, the malady is like the commencement of hydarthrosis with dendritic growth, but the growths are smaller and less numerous; yet no doubt one disease may merge into or become the other; nor shall I attempt to draw a sharp line of distinction, which I do not believe to exist. The malady may, as just stated, end in a hydarthrosis—it may be cured, or on the other hand it may put on all the characters of the more acute synovitis formerly described.

The joint contains a very variable quantity of fluid, but its looseness (*i.e.*, abnormal mobility) is considerable in proportion to the amount of effusion; the ligaments are much affected, their fibres intermixed with new inflammatory tissue, which lies looser and less firmly to the bones, although interstitially condensed.

Symptoms.—This malady, as it usually arises from a more or less acute attack, has generally a definite pedigree, be it a rheumatic fever, a certain injury, a well-remembered exposure to cold, or both these latter combined.[1] If the case originate in acute rheumatism the condition is sufficiently clear, without further comment on my part; if it spring from the last set of causes the narrative runs somewhat in this wise: after the accident or chill or both, the joint was swollen and painful, it was treated, and after a time got well, or so nearly well, that further surgical aid was discontinued, and the remaining stiffness was expected to subside; yet the discomfort never entirely disappeared, the patient on rising felt the joint stiff (it is most commonly the knee or shoulder), found that straightening it was painful or impossible, and that on first attempting to walk he could not, at

[1] I have found that among my private cases a goodly proportion are due to fishing, *i.e.*, standing without waterproofs in the river, or getting beyond the depth of the fishing-stockings; also to slight injuries while hunting or shooting, followed by getting wet or thoroughly chilled. A case at the end of this chapter is typical of this mode of commencement.

all events without considerable pain, put the heel to the ground,[1] it may be that this continued discomfort is severe and lasting enough to cause the sufferer again to seek advice, or he may trust to its subsidence, or again it may really very considerably abate. Even in this last event the patient is conscious of a variable degree of stiffness and difficulty of certain movements in the morning, and though after some exercise these symptoms will disappear, yet it is precisely on the morning after a day of considerable exercise, when the joint appeared most free, that an increased amount of inconvenience is felt. Also, after some unusual exertion, a little over-fatigue or over-work, mental or bodily, perhaps after some error in diet, or slight depression of health, the limb instead of feeling well, or nearly so, seems both stiff and heavy. Generally, too, under such circumstances vague and uncertain pains will be felt in other joints of the same limb, or if the diathesis be strongly marked also in distant joints, between the scapulæ, or in the spine. Soon the peculiar stiffness, at first only noticeable after rest in bed, will also be felt after sitting down for a few minutes or keeping the joint in flexion for half an hour or so. Afterward the limb becomes obscurely painful during rest in bed ; there is difficulty in finding a comfortable position, and the same posture will not be comfortable for long ; soon afterward there comes on a tendency to cramp in the flexor muscles, and if the patient feel them with his hand, even when not cramped, but merely aching, he finds them stiffened and hard ; more especially if the affection be at the knee, is the biceps contracted, and often painful. At this period the joint itself will not be much swollen—occasionally a little increase of fluid may be found, there is no tenderness on pressure ; but movement, especially after long quietude, causes crackling—very fine in some cases, in others coarser. Imprudences in diet (in what is drunk, rather than in what is eaten), changes of weather, getting wet, being insufficiently guarded against unexpected cold, over-fatigue, mental or bodily, exacerbate the trouble, which rarely in this nascent state advances *gradatim*, but by intervals of ease and periods of pain.

At last the patient is conscious that the attacks are longer and more severe, while the intervals are shorter and even less free than before, and he begins to think the joint is getting worse ; he may more especially be sure of this, if the extensor muscles on the upper, and some muscles of the lower segment participate, as is usual at this stage, in the discomfort ; and if, as is even more common, the limb begin to waste.

Now if surgical advice be sought the patient will be found not ill ; but not quite well—there is a sense of irritability. The tongue is rather white and marked at the edge by the teeth—bowels inclined to be irregular, sometimes constipated, sometimes the reverse—the urine very acid, depositing lithate of ammonia in abundance, or not unfrequently, the cayenne-pepper-like lithic acid. The breath has a faint and sour odor, chiefly detectable in the morning before taking food, and some patients even volunteer, that they have an acid taste in the mouth ; these last symptoms, especially the matutinal acidity of the breath, are most marked in those who take too much stimulant, even though far short of what is usually called excess ; but it is occasionally observed in those who are abstemious, or are even total abstainers.

Each of the attacks will leave additional thickening of the synovial mem-

[1] If the shoulder be affected lifting the arm sideways, if the elbow, outward rotation of the hand, if the wrist, rotation outward and extension are the painful movements. The hip is most sensitive to abduction and rotation outward, the ankle to extension.

brane and peri-synovial tissues, as also more narrow limits to movement. In the first few exacerbations, the shape and appearance of the joint resemble that of subacute sero-synovitis; it is rounded and fluctuates, afterward the condition assumes the characters of old disease, in that the normal form of the sac caricatured by distention (see p. 32) is now changed. It is of a square, angular character, which is very distinctive; the outlines of the swelling tend to the straight, and the edge of the tumefaction, felt on tracing the contour of the limb downward with the hand, is clear and defined. This shape appears to me due to the contracting nature of the fibrous material, which, being toward the centre, draws the subcutaneous tissues and the skin itself inward. The tumefaction is hard, elastic, in most parts leathery, and, unless the cavity be full of fluid, there is no sense of fluctuation over the joint as a whole; and even in this contingency the wave is felt to be separated from the finger by a dense tissue. The bursiform prolongations of the synovial sac are favorite seats for formation of fibrous tissue, and thus in the knee the subcrureal sac, in the elbow the pouch beneath the anconeus and triceps feel hard and lump-like, very much like additions to the lower part of the muscles, or like pads of india-rubber. In old cases the fluid will, in one or perhaps two places, approach nearer the surface, the wall having become thinner in this situation, where it fluctuates, feeling not unlike a deep abscess.

After a time, starting pains will be added to the other distresses, and these are more violent than is usual at this stage of the strumous form of malady. I have seen a poor fellow start up and seize the knee in a sort of fury, grind his teeth in agony, and break out in a clammy perspiration; but this case exhibited them in an unusually violent manner. The limb, already much thinner than the other, begins now to waste very rapidly and remarkably; the muscles, particularly the flexors, get thin, while they remain contracted, feeling tight and sharp, like cords beneath the skin. Tenderness of the joint-surfaces is not usual, and when it comes on lasts only a little time; on the other hand, bony grating is common, and often continues to the end of the case. The heat of the part is greater than the slowness of the inflammation would warrant us in expecting; it is not of course equal to that of acute rheumatism, but is more than in any other form of chronic synovitis and considerably above that of the fellow-joint.

The redness is in the first few attacks well-marked, afterward less so, probably on account of the greater thickness of parts; but in the continuous inflammation, which always comes on unless the malady be cured, the hue of the joint is deeper and of a browner tint than the rest of the skin. The brownish hue which may have been imparted by the action of blisters is not, however, to be mistaken for a morbid symptom.

The joint is not unfrequently movable in an abnormal direction; the tibia may be pushed back, even from side to side, or the ulna may be moved laterally over the humerus. This is sometimes accompanied by very severe pain and violent spasmodic contraction of the muscles, setting the limb fast until the bones are replaced; sometimes, on the contrary, no pain is produced. The abnormal movements are always attended by a peculiar hard grating, harder but less rough than the crepitus of fracture.

The sheaths of tendons, as for instance of the ham-strings, if the malady be situated in the knee, may generally be found, in advanced cases, thickened and enlarged, as well as hard from retraction of the contents.

It is worthy of notice, that as the constitution fails in strumous cases, the lungs and brain are extremely apt to suffer from a rather rapid form of tuberculosis. In rheumatic cases the former organs incline to be affected

with a peculiar dry form of bronchitis: there is expectoration, in the morning, of little hard lumps of mucus, more or less dark in color, and the bronchial sounds are harsh and whistling; the mucous membrane of the tubes is thickened. The heart, in one case that I saw, was slightly diseased; there was a rough sound on the systole; how long this had been present could not be determined, but it increased perceptibly as the case went on. Such an addition to the disease is, however, a concomitant, brought on either by previous acute rheumatism or by the general diathesis, and though not, of course, immediately connected with the joint-affection, either as cause or effect, should always be looked for.

The dendritic form of rheumatic synovitis is in its symptoms entirely different. It has, as a rule, no clear history or genesis, but commences gradually, the patient scarce knows when or how. The pain is slight, being rather a sense of weakness, distention, and unreliability, except after some prolonged exercise or over-fatigue; therefore, on rising in the morning, the limb is at ease. Occasionally, in walking the patient feels a sharp stab of pain, which may last a considerable time, or in other cases is more transitory. The joint is more rounded than in the other form of rheumatic malady, less so than in acute synovitis. Examination will detect fluctuation and if, on the most accessible parts of the synovial membrane, as on either side of the patella, or at the back of the elbow, pressure with the finger be made, and the soft parts be moved backward and forward over the bone, crepitation larger or smaller will be felt. This lies sufficiently distant to make it plain that the roughness is not subcutaneous. Moreover, if the surgeon grasp the joint firmly in two hands, with the palms and fingers, so as to get as much sensitive surface next the articulation as he can, he will feel, as the patient alternately straightens and bends the limb, a peculiar crackling. This sensation is entirely different to that of bony crepitus, or even to the softer crepitus of cartilage in a state of ulceration. I can compare it to nothing better than to a tangible rustle of silk. If a piece of stout and stiff silk be folded between the finger and thumb, so that two surfaces are in contact, and if these be rubbed together, the sort of friction conveys to the hand a sense exactly like this particular crepitus. In such an articulation careful palpation will often detect little lumps or nodules evidently in the joint cavity, which move and glide away when pressed upon; there may be many of these, or only one or two, they do not glide far, but can easily be found again in the neighborhood. Sometimes pressure in this way gives to the patient an uneasy sensation. After a time abnormal mobility is very common; for instance, in the extended posture of the knee, one may bend outward or abduct the tibia on the femur, and on restoring normal position, the inner tuberosity may be felt to knock against the condyle, like the lid of a box sharply closed.[1]

If cases of this sort get worse they tend in two directions, either to the production of pendulous false bodies within the joint and to the development of cartilaginous plates or fibro-cartilaginous thickening of the synovial membrane (which forms of disease are fully discussed in Chapter VII.), or to further distention and enlargement of the synovial cavity, leading to one form of hydrops articuli, also the subject of a special chapter.

Treatment.—Although the immediate cause of this malady may be traumatism, yet its persistence or recurrence depends upon a diathesis; we have, therefore, to do with both constitutional and local treatment, and with each during the attack and during the remission.

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[1] This symptom connects the case closely with Hydarthrosis, Chapter VIII.

Treatment during the Attack; General.—All inflammations tending to fibrinous development of their products are more especially those that derive benefit from two remedies, namely, mercury and iodine. The former, however, must be very carefully employed, in small doses, not long continued, and even thus only in sthenic constitutions, uninjured by age, intemperance, or other depressant. In such case it may be given by the mouth, or by the skin of the inflamed joint. This latter method will have to be referred to again; and as it is valuable, the surgeon should remember that he may deprive himself of this resource if the mineral be otherwise administered. Should it be determined to use mercury internally, the most commendable forms are soluble; partly because sufficient effect can be attained with much smaller quantities of the drug, partly because we know really what doses are taken into the system, which we can never estimate with the solid forms. Moreover, when we stop the administration, absorption ceases, which is not the case when about the intestinal folds and villi portions of the insoluble protoxide or chloride may remain hanging. I prefer, therefore, the perchloride or the biniodide (Formulæ X. and XI.), or a larger quantity of iodine may be given in the combination. Two precautions in regard to this drug are to be observed: it should never be allowed to affect the gums, or even the breath; it should not be used while there is pyrexia, not even when the evening rise of temperature exceeds the norm by more than a decimal or two.

In the choice of this remedy, or if using it at all, in the period of its discontinuance, we may judiciously take the urine as a guide; a large sediment of lithate of ammonia, pretty deeply stained, does not contraindicate the use of mercury, although a red sand, the pure lithic acid, does, to my mind, form an objection; also, if the fluid be very acid, and often in such urine the mere precipitation of the lithates is no proof of their excess, mercury may well be omitted, lest it take the place of other and more valuable remedies. Neither do I think that in such condition the action of that medicine is always satisfactory.

Of iodide of potassium I shall have to say a few words in the sequel. Here it is only necessary to observe, that if given during pyrexia, its possible effect of increasing that condition must be watched, and should this follow, the drug should be discontinued. It is most useful in the earlier phases of this disease, when the diathesis is strongly marked, especially when the synovitis is a relic of acute rheumatism. Such constitutions are able to bear rather large doses, the effect of which is increased by the addition of ammonia.

If the urine be highly acid, and be loaded with lithates, more especially with red gravel, this drug, combined with bicarbonate and nitrate of potash, or with carbonate of ammonia, rendered effervescent, if one will, with citric acid, is most valuable. With these may be joined, if desirable, small doses of colchicum. (Formula XII. or XIII.)

This last, as in all cases of rheumatic synovitis in which pain is a prominent symptom, and the lithic acid diathesis strongly marked, is most valuable. I have seen very severe suffering relieved by it alone. Caution must be employed, lest the drug cause too great depression; for occasionally even small but continued doses of colchicum are followed by intermittency of the pulse.

The use of opium in all rheumatic disease is well known. It acts not merely as a sedative or anodyne, but also as a sudorific, and appears to render the urine less acid. From five to ten grains of Dover's powder at night is often very beneficial. In severe cases five grains may also be given during

the day. A combination of opium with antimony and bromide of potassium is frequently very beneficial. In this manner, or if the skin be dry, James's powder may advantageously be used.

Within the last few years a drug has been introduced into medicine, whose control over rheumatism and rheumatic inflammations is very considerable. Since, in the early part of 1876, Dr. Maclagan[1] published his cases of acute rheumatism treated by salicine, this disease has lost nearly half its terrors. Of its use in the fever I am not entitled to speak, but to its value in this form of synovitis I may testify. The special disease over which it has most control is rheumatic fever. Secondly, that which is left after such attack; but it has marked effects in all cases of rheumatic synovitis, when there is some pyrexia (100°–102° Fahr.) and when the urine is markedly acid with plentiful deposit.

More important perhaps, than any drug, is the regulation of the diet. While any feverish symptoms continue, and while the urine exhibits abundance of lithates, butchers' meat should be taken very sparingly, or not at all; the food should be plain and simple, no pie-crust, very little sugar, and no beer. Sometimes we may find a difficulty in cutting off all stimulus; if any be given, a little old and pure whiskey is certainly the best, if it do not, as sometimes happens, derange the liver; if wine must be given, claret and hock are the best; Moselle is also tolerably harmless, but port, sherry, champagne, and more especially burgundy, must be strictly forbidden. To this subject I must shortly recur.

Treatment during the Remission; General.—We now come face to face with one of the most difficult problems of our art—the endeavor not to cure a disease, but to change a diathesis, and it may well be asked if we can ever succeed? Diathesis may be taken to mean the aggregate result of all habitual functional aberrations, of all peculiarities in bodily acts, which in their entirety are simply animal life, such as assimilation of food, change of tissues, discharge of waste, etc. We may well ask if any drug, any mode of life can change the entire chemical and vital dynamics of corporeal existence. The reply must very much depend upon the circumstances producing the conditions in question. A certain tendency of body inherited from past generations, fostered perhaps by youthful, happy disregard, or, at least, never combated until pain assumes an imperative mood, may hardly be overcome, though it may be alleviated and modified. But a rheumatic state—a lithic acid diathesis—in the first generation, brought on by overtraining—frequent exposure to cold—free use of beer and sherry—bodily indolence, or other such cause, may certainly be eliminated, and with the more ease the earlier it be attacked. In this phase much the same drugs as in the condition just described may be used, but somewhat differently. Mercury only as an alterative can be given for short periods of about a week, with advantage, if the bodily strength be considerable. Opium and antimony are better avoided. Our sheet-anchor in the way of drugs will be salicylic acid or a compound, iodide of potass, potash and ammonia very occasionally, colchicum in alterative doses. Let it be remembered that to do any good these are to be taken for a long time, and we must not, therefore, let the doses be large. Also much care is necessary, not too greatly to lower the patient, or to weaken digestive powers; hence many of these medicines should be combined with a tonic. Quinine or iron may both be given cautiously, especially the latter, with either mercury or iodine, even with both; the liquid extract of bark, gentian, and other bitters are all

[1] Lancet, March 4 and 11, 1876.

available. A potent remedy is the water of the Woodhall Spa, in Lincolnshire. I shall have occasion to speak of this in the sequel. (See Chapter XI.) Here I will only say that properly given, and carefully watched, it is very valuable, and that I have found the greatest advantage from its use.

The diet is by no means the least important part of treatment, but is often the most difficult. Persons with this diathesis are peculiarly liable to acid dyspepsia, they avoid bread, dislike puddings, either of rice, sago, or arrowroot, and will not touch milk; they are almost exclusively carnivorous, and the stomach (which is very much a creature of habit) quarrels with any other food. But all this must be slowly changed, for as long as the urine is strongly acid and lithiferous, we must check the consumption of meat—at all events of the brown meats; substitute bread-stuffs, by giving toasts, fried bread, eggs in various ways. To these persons some stimulant with food is, for a time at least, essential, since without it the contact of food excites in the stomach excessive secretion of acid; this stimulus is generally the very worst, either sherry, champagne, or both.[1]

The obstinacy of habit is often my greatest enemy. It is astonishing how difficult it is to convince most men that the thing they have done all their lives, without immediate ill-effects, while under forty, may, nevertheless, be the chief cause of their woes when approaching fifty. Nevertheless, an entire change must gradually be brought about. I say gradually, because I do not believe good is to be got out of any sudden and precipitate revolution, and because the whole round of social life, the dining out, the interchange of hospitality, etc., etc., are all involved in the question of diet. Thus few people can mentally bear to have all their cherished habits altered at a moment's notice; or to be told that what from their earliest youth they have believed to be the way English ladies and gentlemen ought to live, is for them bad and injurious.

Perhaps no more need be said to show, that tact must be as much employed as knowledge in managing such cases. One resource, if other efforts fail, will help to break down the evils of habit—a few months at a Continental bath: Buxton, Bath, Harrogate, and even the almost unknown Tenbury, contain waters which are, for most cases, quite as good as Kreuznach, Aix, Carlsbad, and others: but if besides the mere benefit of the waters, other objects are to be aimed at, no place in England (to which the patient will go) is so suitable as some spot abroad, thoroughly given up to the deity of the Brunnen, where so many minutes in the bath, and so many tumblers of the spring is the end and aim of the day's existence, and where the accustomed sherry and champagne are not the fashion.

But there is another condition of system which is sometimes combined with rheumatic synovitis, namely, asthenia, and this is generally notified by pale urine, either very slightly acid, neutral, or in the worst cases alkaline, the sediments in which are phosphatic. Here an entirely different system, both of diet and medication, must be pursued. Almost every drug above mentioned, save salicine and the tonics, must be tabooed. Quinine, iron, nitric and hydrochloric acid may all in turn be exhibited. Alkalies act injuriously in these cases. Stimulus, even sherry and champagne, but more particularly the latter, may be given at meals; while a diet more or less generous, according to the debility of system and alkalinity of the urine, should be allowed. Here then are two opposed conditions of system, and two entirely different methods of treatment. Let me remind my reader

[1] "The glass of sherry after my soup" is a rite very difficult to abolish, still more the "half glass of sherry at my club before I go home to dress for dinner."

that what I will here call acid rheumatism may be very disadvantageously changed into alkaline rheumatism, by a too long continuance of alkalies, and too depressant a treatment. With very much more difficulty may the alkaline form be reversed by over-feeding and stimulation. He who is wise will be wrecked neither on Scylla nor Charybdis.

Treatment in Acute Stage ; Local.—If we have to deal with a relic of rheumatic fever, we must carefully look to the posture in which the joint has been allowed to rest, for, during that disease, movement may have been so painful as to render the physician unwilling to add to his patient's sufferings and pyrexia, by insisting on a surgically good position.[1] It may be that the limb is undesirably bent, or even some subluxation may have occurred. This must be rectified, a splint applied, and the already described conditions of skilful surgical treatment enforced. It is hardly necessary to say that absence of fever is presupposed ; we are not dealing with the latter part of acute rheumatism, but merely with a rheumatic joint. When a good position is attained, the inflammatory condition will sometimes almost vanish of itself ; it will, at all events, have been rendered more amenable to treatment. If the joint be hot, red, and tender on pressure, some local bloodletting, after the method already described, is often advantageous ; heat by the salt-bag is beneficial ; cold is not usually advantageous ; but when heat is disagreeable and cold grateful to the feelings, it may be cautiously employed. Liquid effusion into the joint-cavity is rarely sufficient to require puncture, but, on the other hand, the peri-articular tissues often contain fluid, as evidenced by a small amount of pitting, or at least whiteness of surface after pressure by the finger. In such cases the part may be covered with cotton-wool, over which a quantity of spirits-of-camphor has been poured, and allowed almost to dry ; or into which finely powdered camphor has been shaken, and this is to be tightly bound with a flannel or domett bandage. I have also applied salicylate of soda in strong solution, by soaking in the fluid strips of lint, with which the joint should be strapped, and the whole covered with one of the above-mentioned bandages.

When the severity of the inflammation has subsided, local applications of mercury may be used advantageously, if the drug have not been given by the mouth, save as a mere purgative. If the constitution be sthenic, and if the fluid part of the swelling have disappeared, leaving considerable fibrous enlargement, having a cork-like, hard feeling, the camphorated blue ointment, pure or mixed with an equal proportion of iodide of potass ointment spread on strips of lint, may be strapped on the joint, covered with thin mackintosh and a flannel bandage. The systemic effect will require watchfulness. The oleate of mercury, a compound introduced by Mr. Marshall, is elegant and efficacious ; moreover, the mineral may be dissolved in different proportions : 1 in 20, 1 in 10, and 1 in 5 of oxide of mercury, to the acid permitting of variations in potency of the application. About twenty minims is the average quantity to be painted on or lightly rubbed into the skin twice or at most thrice a day ; but, unless a pretty sharp pustular counter-irritation be desired, it is well to mix the solution with about an equal quantity of oil or of lard. I have found this preparation valuable when considerable thickening has been produced by the inflammation, and believe that it acts rather more quickly than the mixture of blue and iodide of potass ointment, and certainly more quickly than the former

[1] After severe fevers it is very common to find the ankles much flexed—the feet in equinous position.

alone. Another valuable advantage of thus employing oleic acid as a solvent, is the power it gives us of combining other drugs: thus one or two grains of morphia (the alkaloid) may be added to each drachm of the oleate, or of atropia half a grain to the drachm. These preparations are very valuable even in the inflammatory stage of rheumatic synovitis, particularly if accompanied by considerable suffering. The morphia compound, when the pain is continuous or nightly, the atropia when it is more paroxysmal, and especially if of the starting variety, may be employed with very considerable advantage. Also, it should be said, that although as a rule I would advise mercury, yet the combination of oleic acid with one of the sedative drugs above mentioned, may be used alone, especially if little or no fluid be in the peri-articular tissues, if the thickening be inconsiderable but the pain severe.

Or—but not in combination with the above remedy—blisters may be applied on those localities already specified as most available. By these means, in conjunction with the suitable constitutional remedies, we can generally subdue the immediate mere inflammation; but if, during the fever and the few subsequent days, so much mischief have been done to the joint that we can only hope for anchylosis (true or false), we must carefully and sedulously watch the position of the limb, so that as soon as more quiescent symptoms permit, we may use some passive motion, or at least occasional change of position; thus preserving as much mobility as possible within the range of a surgically good posture.

The management of cases originating in slight traumatism combined with chill, will first be conducted on the same principles as for simple acute or subacute synovitis, but on the subsidence of inflammation, and on the appearance of those recurrent symptoms described at p. 145, a somewhat modified plan is necessary, and this will depend on the amount of inflammatory action still persisting. The fact that after rest there is pain, warns us that entire immobility may end rather rapidly perhaps, in considerable stiffness. Hence, even though the patient may not be allowed to walk or to exercise the joint, yet movement should be used according to the amount of pain and swelling. Shampooing, with passive motion, frequent frictions (often these may be self-applied) will be beneficial. If the knee be the affected joint, I often order the patient to sit on a table, attach a weight of two or three pounds to the foot, and swing the leg for about ten minutes twice daily. At night the joint may be wrapped in a flannel roller, dipped in a solution of bicarbonate of potash, ten or fifteen grains to the ounce, and this may be enveloped in thin india-rubber sheeting. If, when the patient gets up in the morning, there be difficulty in straightening the limb, a pasteboard or poro-plastic felt-splint should be moulded to it, in the straight or nearly straight position, and either strapped or bandaged on during the night. Also he must get into the habit, when sitting to write, read, or dine, of keeping the knee rather straight, and for this purpose a footstool or leg-rest may be provided. The difficulties and pains already described will not occur on bending the limb; flexion is the peccant tendency.

Should an exacerbation occur, movement must stop for a time, mercury locally, a blister, either a carbonate of potash bath, or compress, and entire rest for a few days, in a splint be enjoined, while constitutional remedies are exhibited; both local and general treatment are to be gradated on the severity of the attack. Frequent recurrence, each one leaving more thickening than the last, shows us that the dyscrasia is more potent than our remedies, and now, it may be that a retentive bandage of some light material,

as dextrine or silicate of potash, should be applied, and the patient sent to Harrogate, Bath, Buxton, or to Aix, Carlsbad, Kreuznach, Vichy, as the case may be. If from financial or other circumstance this cannot be accomplished, we must, while modifying the plan of constitutional remedies within the lines above specified, treat the case locally more severely, or change the remedies from one to another of those named. A long course of blisters applied alternately to different parts of the surface so that one is always open; even two lines of the actual cautery, or on the other hand simply long retention in an immobile apparatus (this generally connotes more or less anchylosis) may be the only remedy, but in my experience these cases are quite amenable to treatment, if the sufferers be sufficiently docile, and—for generally the cure will take some considerable time—if they do not lose patience.

The other form of rheumatic synovitis will, unless the fluid be large in amount, require much the same management. When there is considerable effusion within the synovial membrane, the most successful treatment is to withdraw this with the aspirator, and immediately to strap or to bandage the joint with an elastic web-roller and with very considerable pressure. When the fluid is withdrawn crepitation is often very distinct, and little nodules may not unfrequently be felt. I have often found on removing, after a fortnight, the strapping or bandage, that both these symptoms have disappeared, and some rubbing, with passive motion, has perfected the cure. But for so successful a result, the case must be taken early. Blisters or rubefacients will after either procedure be of some avail. On two different occasions I, on the third time of using the aspirator, passed into the joint two drachms of three per cent. solution of carbolic acid; in one of these the result was excellent, in the other good, not quite so perfect. If, indeed, the inner surface of the synovial membrane be rough and hirsute, with dendritic fringe-hypertrophy, I really do not see how such a case is to escape constant serous effusion, and reiterated attacks of inflammation, unless some such means be taken. I consider that aspiration of the cavity, followed by pressure, causes absorption, shrivelling, and decadence of the growths, while the injection probably produces the same effect by causing an effusion of lymph from the surface, matting the little growths together, and once more giving to the membrane an even if not polished surface; that much of this fibrin is afterward absorbed, together with the organisms it enclosed.

Case XXXVIII.—Captain B. sent for me to see him October 4, 1876. During a great part of the previous year he had suffered from a severe and painful affection of the right knee, which under treatment in Dublin got well; but almost immediately afterward the left knee became very painful and swollen; the same surgeon treated him for four months, at the end of which time he came to London and consulted me.

I found the knee considerably swollen and the thigh much shrunken; the enlargement was hard and resilient, while on deeper pressure a sense of slight hypersecretion into the joint could be detected; the shape of the swelling was rather square, the subcrureal sac of the synovial membrane was full of a deposit, feeling like fibrinous material, whose edge could be plainly distinguished. The joint was very painful, especially at night. The tongue was rather white with teeth-marks at the edge—the pulse 110, temperature at 4 P.M. 100.2°. He had a distaste for food, but was very thirsty; the urine very acid, contained great abundance of lithates, but no albumen. I made out that the first affection, that of the right knee, had

come on after he had been standing in the river fishing without waterproofs.

I ordered a leather double splint to be made—the knee being kept nearly straight, and an ointment consisting of three parts of the iodide of lead, five of the iodide of potass ointment, to be kept applied by means of strips of lint—prescribed the effervescent citrate of ammonia every four hours. To leave off sherry and beer, and to take instead 1½ oz. of whiskey in the middle of the day and the same quantity at night—also ten grains of Dover's powder at bedtime.

October 6th.—Very much better; pain had very much decreased (partly attributable to the splint), and the swelling was less. The pulse had diminished in frequency. Appetite returning; temperature nearly normal. Less discharge of lithates in the urine.

October 13th.—Still improving—to discontinue the ammonia and to take iodide of potash with bicarbonate and citrate of potash.

December 5th.—The case went on uninterruptedly well. On November 28th frictions were ordered and swinging the leg, with a two-pound weight attached, for ten minutes twice a day, and then to reapply the splint. At above date he returned to Ireland, promising to carry out all the ordinances, increasing week by week the passive movements, and after a time to use active motion, and to discard first the inner, then the outer case. In the spring of 1877 he returned, able to walk without a stick. The stiffness remaining was shown by an inability to bend the knee to the full, or to kneel on it without getting rapidly fatigued; and, what he more disliked, inability to quite straighten the joint. He was shown how to lie prone on a sofa, weight and swing the leg in the direction of extension, and he rapidly got better, so that at the end of June he was able to go with his regiment, which was ordered to Malta.

April, 1878.—Captain B. wrote that he had met with an accident in stepping into a boat, and the knee had again swollen and become painful. He thought, too, that the climate did not suit him; shortly after he obtained leave of absence. When I saw him in May, it was evident that the joint was not by any means in so bad a state as on the first consultation; but he said that it had been much improved by the voyage and the reapplication of the leather splints. He was, however, very rheumatic, and a repetition, with slight variation, of the same means, was followed by rapid improvement, and in August he rejoined his regiment just then ordered to India.

Case XXXIX.—Mr. G., aged thirty-nine, asked me to call on him—suffering from knee-joint disease, March 2, 1874. His business, connected with certain railway appliances, led him occasionally to ride on the engine. About a fortnight previously he had thus got wet through, and was too cold to feel his feet, so that he fell and strained the knee, apparently only slightly, nor did he feel more than slight stiffness till thirty-six hours before sending for me. Two nights previously he woke up suddenly with severe pain, which lasted the rest of the night. In the morning the pain decreased, and during the day was so slight that he expected to get well rapidly, but again in the night a more severe pain set in, and lasted until late in the morning. I saw him on the same afternoon, and found some pyrexia, temperature 101.3°, quick pulse, no appetite—urine loaded with lithates. Ordered a leather splint—blisters (merely rubefacient) above the joint. Two grains of blue pill and half a grain of colchicum night and morning for four days, afterward medicines to diminish acidity of, and lithates in the urine. He had been drinking sherry and champagne; these

were stopped. Morphia was given at night; the case proved rather obstinate, and he had to be kept in bed nearly six weeks—and then was allowed to lie on the sofa. Five grains of iodide of potass with three of carbonate of ammonia and fifteen minims of the tincture of actæa racemosa. Knee tightly strapped with the mercury and ammoniacum plaster.

May 19th.—Knee very much better. Passive movement by swinging with weight attached. Friction rapidly diminished the size of the joint.

June.—He could walk well, and went by my advice to Baden, where he quite recovered; on his return later in the year no trace of the malady could be seen.

Case XL.—Mr. G. L., aged twenty, struck his knee, when hunting, against a gate that swung back upon him, in March, 1879. The weather was cold and rainy, he was wet, and had some distance to ride home. The knee was very painful and somewhat swelled; he kept wet rags upon it, and in a day or two it was much better, but he still for a fortnight had difficulty in walking; sometimes at night he was awoke by pain, and had to rub the knee and alter its position. These troubles, however, seemed to get better, until in June, when he, in playing lawn-tennis, sustained some slight strain, which obliged him to stop, and gave considerable pain. Three days afterward he sent for me, June 16, 1879: I found the joint swollen, rather hard and resilient, not containing any excess of fluid, rather of a square shape. The urine contained a considerable deposit of lithates, varied occasionally by lithic acid red sand. He was in the habit of taking wine rather freely at dinner, and also usually a rather large glass of sherry—sometimes two—in the afternoon. His tongue was clammy, rather white, and indented at the edges by the teeth. I kept him in bed, and had a splint moulded to the knee. Ordered a rather smart purge, effervescent ammonia and entire abstention from wine, permitting, however, a little whiskey and water; the pain was very considerable, and he had to take one-half grain of morphia every night. In eight days I allowed him to lie on the sofa, and shortly after to drive out while the splint remained on and the knee was tightly strapped. As soon as he got out and to his clubs he began, in spite of my direction, to take sherry again, the urine again contained lithates, and the knee began to be painful, especially at night, waking him two or three times, and then keeping him some time from sleep. After a short sermon on his folly I ordered him the Woodhall Spa water, six ounces of whiskey in three doses during the day, oleate of mercury 5 per cent., to be rubbed in night and morning.

August 15th.—Very much better, sent him to Kreuznach. When he returned to England in the beginning of October his knee was nearly well, but he has been obliged to see me on several different occasions. The joint could not be quite as much bent as the other, and a very slight enlargement remained. His troubles were occasional returns of pain, more especially at night; these are always, if not directly, traceable to some error of diet—at least are always combined with lithates in the urine. He hunts and shoots without annoyance.

Case XLI.—G. D., aged thirty-five, foreman of builders' carpenters, rather addicted to drink, but short of absolute intemperance, came under my care in Charing Cross Hospital, June 6, 1875, with a considerable swelling of the knee. The joint contained some excess of fluid, but was rather hard and resilient, square in form. He had got wet through several times, but had no remembrance of an injury. He thought the disease began about eighteen months previously, when he had to lay up for about ten days, and then got to work again, although with some considerable pain and diffi-

culty. The present attack began seventeen days previously; he had kept quiet at home for a fortnight before presenting himself.

A large-sized aspirator needle was passed into the joint, and three ounces one drachm of a slightly opalescent fluid withdrawn, which on standing, deposited abundance of cells. The emptied membrane, when moved by the palms over the bones, crepitated, and a number of little bodies, from the size of a mustard-seed to that of a dried pea, could be felt. The limb was put on a MacIntyre splint, iodide of potass three parts and the blue ointment one part were kept applied, and firm pressure by bandage employed.

June 14th.—The knee had not filled again, crepitation of synovial membrane less evident, strong strapping-plaster applied.

July 2d.—On removing the strapping, I found the joint sufficiently well to permit the man getting up, a leather splint being moulded on the outside.

July 20th.—Discharged at his own request, could walk with a stick, ordered to procure an elastic web-bandage and to use rather strong pressure over the joint. The little bodies could not be felt, but a slight silken crepitus, when he bent and straightened the joint, was evident.

Case XLII.—Jane S., aged forty-nine, was admitted into Charing Cross Hospital under the care of Mr. Hancock, May 7, 1867. The woman had suffered for twelve years from disease of the left knee. She had had acute rheumatism in 1854, and though she appeared well she always had some pain and trouble in that knee. Since then the joint had occasionally been very painful and swollen, and had got better alternately, but in the last eighteen months has been nearly always bad, incapacitating her from any employment.

The joint was generally rather hard, somewhat square in shape; the tibia movable in many abnormal directions. As the knee was plainly disorganized, and the patient's health much affected, Mr. Hancock amputated in the lower third of the thigh on May 25th.

Examination.—The synovial membrane was greatly thickened by tough fibre-tissue; its inner surface was rugous as though in folds; it was uneven rather than rough. The latter ligaments were buried in this tissue, and in great part changed into a like material. The cartilages were very peculiar—in some spots very thin and of a light brown hue, in others absent, not by ulceration, since the surface-level was in such places unaltered (ossification of cartilage). In one spot on the inner condyle was a depressed part, about the size of a sixpence, in which the cancellar bone-structure could be seen. Lying in the cavity of the joint was a piece of cartilage with the remains of the articular lamella still attached, which precisely fitted this hole, which was surrounded by an almost complete ring of ossified cartilage. At the back of the condyles portions of the cartilage were fibrillated. On the tibia only a few parts were covered by thinned cartilage; in other parts it was fibrillated or had disappeared.

CHAPTER VII.

ON SOME OTHER FORMS OF SYNOVITIS.

The strumous and rheumatic diatheses are those which chiefly produce or maintain a chronic inflammation of the synovial membrane; but there are besides two other conditions having the same effects: these are Syphilis and Gout.

Syphilitic synovitis, although rare, is sufficiently common to deserve some notice. The malady appears in two manners, the one, combined with an acute outbreak of syphilitic intoxication—pyrexia, throat ulceration, and shin eruption—is poly-articular and usually evanescent. At present I am in doubt whether the joint-affection is a direct sequela of the syphilitic poison, or one of the absorption diseases analogous to those which occur in the course of measles and other exanthemata. The other form, essentially chronic, is mon-articular, the symptoms of which lead me to believe that the inflammation always spreads from the periosteum. In some cases I have seen, nodes on the shin were present at the time, giving severe nightly pain; in others, these pains were subsiding; in one a suppurating node close to the joint had been incised.

Syphilitic eruptions are often present at the very time when the chronic joint-attack commences, and by proper inquiry a specific history can generally be made out. I am not aware of any case in which this disease has occurred previous to other constitutional effects of the *lues*.

The disease is confined to the middle period of life; its usual history is this: The patient having been subject to the usual secondary and tertiary symptoms of syphilis, labors during some days or weeks, previous to any complaint having been made of joint disease, from nightly pains of the bones, probably also from swellings along the course of the shins, with whose aspect and history every surgeon is but too well acquainted; then at some period a joint becomes painful, and swells. At first the tumefaction of the part is slight, and is not so much due to effusion of fluid into the cavity, as to an exudation into the peri-articular tissues: this is evidenced by the want of fluctuation and the softness of the parts beneath the skin; they do not pit, but they have a tendency to do so; very slight pressure with the finger whitens the part. Soon after the commencement of the disease, an augmented secretion of fluid into the synovial sac takes place; increased heat is perceptible, and occasionally the skin has a pink flush. During these manifestations of syphilis there is commonly a nightly pyrexia of 100° or 101°. The pain is, at the early stage, very severe, particularly while the patient is in bed, and at the first commencement of the disease; when increased secretion into the cavity has taken place the pain very much subsides.

A less usual form of malady arises with one of those acute outbreaks of secondary or tertiary disease, that occasionally occurs in constitutions considerably impaired. The usual symptoms are these—a somewhat vio-

lent skin eruption, probably lepra, psoriasis or rupia and ulcerated throat, are accompanied by severe though somewhat vague and wandering pains in the bones, the back of the neck and jaws—the suboccipital and other lymphatic glands swell, the pyrexia is well marked even in the day, the nightly rise is considerable. A few such cases suffer from joint disease, which is multiple and pretty severe; but even without treatment is usually transient, and with proper medication disappears very rapidly.

There is great difficulty in concluding or in proving that any one isolated case of such disease is a true syphilitic manifestation, especially as upon sufficiently persistent inquiry some admission of exposure to cold can from most persons be elicited, and, as we frequently find, combined with the other troubles irritation of the Schneiderian, laryngeal, and pharyngeal mucous membranes which may arise from catarrh, syphilis, iodism, or even mercurialism. Still, although in some instances the joint-affection may be absorptive or slight rheumatism concurring with a certain cachexy; yet I think sufficient evidence exists to show that there is a poly-articular subacute syphilitic synovitis unconnected with bone or periosteal disease.

The course of these two forms of the malady is different, the former is often a somewhat obstinate, but not a severe disease; it has a tendency to recur, when the next efflorescence of the poison takes place, and it leaves the joint very susceptible to cold. The latter is as I have said a subacute, generally a transient affection. I have never seen either of them lead to ulceration of cartilages or permanent injury to the joint. The knee and ankle are most prone to these attacks, but the elbow stands not far behind.

Some difference in managing these two forms of disease must be observed. The treatment of the former may follow the usual lines of anti-syphilitic practice. Mercury in small doses, and of all preparations the perchloride or the iodide is the best, as less injurious to the constitution and more antagonistic to the disease than any other; while if nodes with tender periosteum be present iodide of potass will have its well-known influence. In one case rapid amelioration resulted by a compress covered with mercurial ointment bandaged on the limb, while iodine was given by the mouth.

The latter form of the malady is always in my experience combined with considerable debility, with a state of system in which either mercury or iodine is apt to prove injurious, until by some other means the hectic-like pyrexia has been overcome. Either quinine or iron, if they can be borne, or indeed a combination of both, may often be given at once; or, if such remedies are not as yet suitable, vegetable bitters with or without acids, and the extract of cinchona, may be used. If the nightly pyrexia be very considerable, 102° to 103°, the effervescent citrate of ammonia will probably prove the most fitting remedy. After this phase has passed a combination of mercury with quinine or with iron (Formulæ IX., X., XI.), either in liquid or in pill, will probably be desirable.

The local treatment is first of all rest, with a fitting splint to secure immobility of the joint, and superficial counter-irritation by means of iodine, or of flying blisters, only kept on long enough to produce considerable redness of the surface without vesication; the redness may afterward be kept up by the tincture of iodine. It would seem, from the fact of pain being most severe when the patient gets warm in bed, that cold would be a soothing application; this, however, is far from the fact; heat, by means of hot salt or hot-water bags, although producing pain for the first few minutes, procures a more rapid relief than cold. Mercury in the form of

oleate may be employed with great advantage, especially in cases of debility, when we would wish to avoid other modes of administration.

Gout is a disease produced by the presence in the blood of uric or lithic acid ; the local manifestation is caused by the deposit of this material, in combination with soda, in the various tissues of the joints, producing a very painful articular inflammation. Rheumatism is also marked by superabundance of lithates as evidenced by the urine, but no lithic salt is in rheumatism deposited in the joints ; therefore, though both gout and rheumatism have the presence of lithates in common their pathological and clinical conditions are different. It hardly comes within the scope of this work to describe fully either the symptoms, the treatment or indeed the general pathology of this disease ; but a few remarks upon the mode in which the local action is produced appear desirable.

The attacks of gout, like those of rheumatism, come on at irregular intervals, although the poisonous matter accumulates regularly, *pari passu*, in the blood. It seems that the uric acid may go on accumulating to a certain point without producing any painful symptoms, and that then a severe attack will come on, with or without some accidental exciting cause. Each of these attacks is attended with a more or less rapid and plentiful deposit of lithate of soda into the soft textures of the joints ; generally at first of the small joints, as of the toes or fingers ; but sometimes of a large joint, as the knee, the largest in the body, will be the only one affected.

In the acute attacks of the disease, a quantity of the salt is partly dissolved, partly suspended in the synovial secretion, giving it a milky or rather a chalk-and-watery appearance ; and when the fingers are moistened with this fluid, and it is rubbed between them, it imparts a gritty sensation—at the same time a larger quantity of fluid than the norm is secreted ; during these attacks, and also during a more chronic and persistent suffering, the urate of soda is deposited in the cartilages, the peri-articular tissues, ligaments, and even in the bones. The deposition takes place in the form of a chalk-white, gritty powder, in which, under the microscope, acicular crystals are found to be abundant. At first the salt is suspended in the exudation fluid, but soon the mere liquid is absorbed, and the concretion is left dry and pulverulent among the fibres of the part. Owing to the opacity thus produced, there is considerable difficulty in seeing the histological position in which the salt is stored ; but from many investigations which I have made, it seems to me that the atoms group themselves round the cells of the various structures.

The cartilages are sometimes found covered on the surface with the lithate ; this happens during the most acute phase of the disease, while the joint secretion is rendered milky ; the salt then slowly deposits itself on all surrounding parts. Frequently are to be seen little white spots in the substance of the cartilage, and if sections be made through these with a sharp knife, they will be found broader and larger in the depths, than on the surface of the structure. The opacity in these places is so great, that it is impossible to procure sections thin enough to be transparent ; but by teasing out portions very minutely with needles, it may be seen that the lithate occupies chiefly the hyaline structure close to the edge or wall of the corpuscles, while the cells themselves remain free up to a certain point. At some period, however, the cell-walls become invaded, the cells themselves atrophied, when ulceration of the cartilage commences.

In the peri-articular tissues and ligaments, the same mode of deposition is followed ; the cells remain themselves free from the salt for some

time after the fibrous intercellular structure has been invaded. This can only be seen by careful and minute division with needles. In a case that was very far advanced, I found the whole internal lateral ligament of the knee converted into a cyst, which contained a hard almost dry lump of lithate of soda, about as large as the last joint of the thumb.

The bones, on account of their solidity and the compactness of their elements, receive this deposit much more slowly than the softer tissues. In them also it occupies a position round the bone-cells, filling up the intervals between the canaliculi.[1]

The histological sequence of this deposit carries out entirely the pathology of other joint inflammations, as laid down in this treatise. But it should be remembered that lithic acid is in gouty persons deposited in other parts as well as in the joints. The helix of the ears is a very favorite place for little cuticular concreta, which show white through the epidermis ; these spots are usually about the size of a mustard-seed, but sometimes considerably larger ; another place in which small deposits are found is the subconjunctival space of the lower eyelid. Every white spot in these localities is not urate of soda ; sebaceous concretions, or even, as Dr. Garrodo bserves, cholesterine and epidermic scales, accumulating in spots about the eyelids and face, have much the same external look as the gouty salt. A needle puncture and a microscope will always decide in cases of doubt the nature of the deposit.

These concreta, whether in the joints or elsewhere, are deposited from the blood, which, as the above author has shown, is in gout invariably rich in uric acid, and this richness depends on failure of the kidneys to excrete that compound in sufficient quantity. It must not be overlooked that some gouty persons suffer habitually from slight albuminuria, others only during the paroxysm. I believe it was the late Dr. Todd who first pointed out the gouty kidney as he termed it, viz., a contracted granular organ with a few white lines of uric acid among the tubuli, and more sparse deposit in minute nodules in the cortical substance. The contracted or atrophied state of the kidney depends rather on diminution of the cortical, the essentially secreting portion, than on decrease of the medullary parts.

There is, I have glanced at the fact more than once, a remarkable affinity or correlation between lead-poisoning and gout ; that is, persons whose systems, by accident or avocation, have absorbed lead, are extremely prone to be attacked by certain forms of gout, and persons who have undoubted attacks of gout, or even such as are of gouty descent and habit, are on very slight contact with that metal extremely liable to suffer from lead-intoxication. Of this I shall give an instance (Case XLIV.).

Symptoms.—The changes in the joints above described may be brought about by a number of acute attacks, succeeding each other with considerable rapidity and regularity, the intervals being in some cases quite free, in others simply periods of less suffering, or they may result from a continuous chronic gouty condition, with perhaps some occasional exacerbations that may be rather violent or but slight exaggerations of the usual state.

Acute gout at first attacks the smaller articulations, and has a special predilection for the first metatarso-phalangeal joint. The first few attacks usually come on when the patient is feeling quite, perhaps particularly well. After a time the paroxysms are preceded by considerable irritability, often

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[1] In one or two post-mortem examinations of gouty subjects, certain joints have been found anchylosed; this condition I believe to be not a direct sequela of gout, but the result of synovitis, which gout may in the first instance have produced.

by a sharpness of temper, which apprises the man's wife and children, even though he himself may not know it, that a "fit of the gout" is coming. One night (the attacks rarely begin in the day) the patient wakes with a sharp stab of pain in the toe, which leaves behind it a throbbing burning heat, with aching fulness and sense of bursting, increasingly severe until it seems unbearable. The skin becomes red, tight, and shining, veins are clearly marked and raised above the surface, the whole neighborhood is swollen; the patient protests against the very tender part being touched; but when this is done some slight pitting occurs. In the morning the pain generally abates, the patient gets a little sleep, and during the day, as a rule, he is so far easier, that he (unless well acquainted with his foe) may hope for a placid night. But hardly does he get to bed than some throbbing warns him; perhaps he just gets to sleep when a fresh dart of pain rouses him to another night of what becomes little short of torture; and so on through a weary succession of nights, perhaps as many as ten or fourteen,[1] the unfortunate victim suffers. When several such attacks have occurred, tophaceous deposits may be seen in the skin as little white round patches, usually raised from the surface. The foot is constantly tender, ordinary shoes cannot be worn, and more or less lameness results. During this time a certain pyrexia, more especially in that form called sthenic or rich gout, is present, and indeed I have observed that on each nightly attack a rise in the thermometer precedes the pain; the skin is hot and dry, the urine high colored and scanty—often extremely scanty. The condition of tongue, appetite, and bowels varies greatly. The attacks of poor gout, that which affects more feeble persons, especially those who are poisoned with lead, are mere exacerbations of the chronic gout. The affected part is but slightly more painful than usual, redness is not well marked, nor is venous engorgement; on the other hand more œdema is usually present. After either form of attack desquamation ensues, and this may decide upon the reality of an asthenic "fit," which might otherwise be doubtful.

Chronic gout, although any one moment of the disease may be less painful than an acute sthenic attack, is a distressing and destructive malady, because the patient is rarely quite free; the fits, though less violent, are more frequent—sometimes almost continuous. The joints, first and chiefly attacked, undergo more destructive alterations, and fresh parts are constantly being invaded. If we can insure that the disease will remain in the joints, the patient may consider himself fortunate; this is not by any means always the case, as the heart, stomach, brain, or other vital organs, may be attacked (irregular or misplaced gout).

The singular distortions and alterations of form, which are sometimes produced by this malady, would be incredible, if presented to us for the first time. I have now a gentleman under my care whose right hand possesses no joint, in normal posture or shape; the extremity looks rather like a clump of horseradish root than part of a human limb; every prominence, and they are innumerable, is crowned by a white spot of chalk-stone; and almost every depression is red and dusky from hyperæmia and venous enlargement.

The diagnosis of this malady, when the fit is in full bloom, is unmistakable; to distinguish more chronic and milder forms is less easy. Family history may greatly help (atavism is the not invariable rule of descent),

[1] Cases have in former times lasted several weeks. I do not think that with our improved knowledge and therapeutics they should do so now.

and examination of the ears and eyelids should never be neglected ; at the same time it must be remembered that a gouty person may have non-gouty maladies, yet will hardly suffer inflammations that do not partake of the gouty nature, even though traumatic. Anomalous vague distressing symptoms, for which no reason can be found, as sleeplessness, bad dreams, peculiar palpitations, and flushing heats, certain forms of indigestion with distention, in old men obstinate matutinal erections, should lead us to examine for gouty deposits on the skin, but especially to search in the urine for lithic acid, which, unlike that fluid before an acute attack, will often be found loaded with the salt.

Treatment.—As gout has many phases, so must the treatment be differently directed. In an early acute attack of the sthenic variety, the first object must be to check the pain, and this, if possible, without the use of opium, which diminishes the action of the kidneys. Now, of all swift means of effecting this object, colchicum is the most certain, but it is a remedy which requires some caution, since, in spite of the dictum of a great authority on gout, it appears certain that, unless carefully administered, it may be followed by one of two evil consequences : early repetition of the attack, a reliquum of chronic, perhaps of atonic gout. The less robust the patient, the more caution must be employed ; it is a depressant of the heart's action. If, however, we know that we are making use of a tool which cuts both ways, we may judiciously deal with an early attack in a robust person, by giving at once twenty or thirty minims of the wine of colchicum combined with a diuretic, as the bicarbonate, acetate of potash or both with some bromide of potassium, which I have often found of great advantage. But if the pulse be low, under seventy beats per minute, a little carbonate of ammonia may be judiciously added.[1] If the pain be very severe, the colchicum dose may be even larger. Afterward, ten or fifteen minims, with the same quantity of salines, may be given three times in the course of the day ; but cautiously enough to keep in reserve room for the administration of another large dose, if at night a recurrence supervene.

In the meantime we must strictly enforce a non-nitrogenous and non-stimulating diet. All beer and wine must be forbidden, and all meat ; the ideal regimen is simply the bread-stuffs, arrowroot, tapioca, etc., with plenty of diluents. But some patients will not or cannot bear this feeding, and the digestion of certain persons is uneasy without some slight stimulant ; in such cases a little light white-fish, and a small quantity of sound old whiskey, may form the compromise between what is best and what is feasible. If the pain, in spite of colchicum, be severe, the best form of sedative is the salicylate of atropia, the mode of whose preparation will be found among the formulæ (Formula XVI.) ; if this be inadmissible a small subcutaneous injection of morphia may be necessary.

Under such treatment, varied according to circumstances, an attack of acute sthenic gout ought to pass away rapidly.

But much can in the intervals be done to keep such attacks at a distance. Even when, as with many patients, warnings appear, such as unusual irritability of temper, peculiar itchings and heat of skin, certain shooting neuralgia-like pains, etc., the hot-air bath is often efficacious,

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[1] Purging is only desirable if there be either constipation or what is less usual teasing, insufficient alvine discharges ; or again, if the hue of the skin and conjunctivæ be decidedly icteroid, podophyllin, leptandrin or blue pill, the two former in preference, may under either event be combined with other purgatives, to which from a half to one grain of the extract of colchicum may be added.

especially if plenty of water be drunk during perspiration, and afterward saline diuretics and the carbonates—lithia perhaps, though I have failed to find in it any peculiar efficacy. At night, a purge containing either the extract or the wine of colchicum may be administered.

During the period of complete freedom, the same salines may be rather more sparingly used, and combined with them the iodide of potash, or unless some state of heart forbid, small doses of digitalis; this drug is not mentioned in therapeutic books, or elsewhere as a remedy for gout, but I have used it too often, and with too good effect, to doubt its value. I have never employed it during an acute attack.

Chronic atonic gout is to be managed after a rather different system; the possibility of lead-poisoning at some time, even if not present at the moment, must not be overlooked, and the presence or absence of albumen must be verified. While in the latter case diuretics and iodine may be employed, their use must be omitted or carefully watched in the former. The bitter tonics, such as gentian, calumba, chiretta, are generally better digested if some stomachic be added—even bark, either as quinine or the extract, may be employed; infusion of ash leaves (bitter diuretic), greatly extolled, is of somewhat problematical value. The lighter preparations of iron may be cautiously used. If any appearance of lead-intoxication be traceable, iodide of potass, at first in very moderate then in larger doses, combined with diuretics, is the best and most essential remedy.

Frequently one of the alkaline and chalybeate springs will answer better and more decisively than all medicine—Harrogate, Buxton, or Bath, Schwalbach, Vichy, Aix, and a host of others, stand open to the choice of surgeon and patient.

The local treatment of gouty limbs has not, I think, been sufficiently considered, probably because as the *materies morbi* is certainly in the blood, it has been supposed that applications to the inflamed part could do no good. Thus, with the exception of wrapping the inflamed limb in cotton-wool or bathing it in lukewarm water no mode of treatment has been as yet devised. During the acute fit, however, the pain may be relieved, general treatment being of course also employed, by soaking cotton-wool in chloroform, protecting it by another layer, and covering the whole with thin mackintosh. Or equal parts of chloral and camphor, rubbed together into an unctuous semifluid, may be applied on lint, and similarly covered. Aconite as a local remedy sometimes succeeds. More certain than any of these is morphia or atropia, dissolved in oleic acid.

During the remissions much may be done to prevent the crippling and distortion which goes on even without pain as a result of depositions, which took place during the fit. Passive movement and rubbing carefully employed so as not to bring on inflammation, especially upward rubbing with glycerine or thirty drops of oleic acid slightly smeared on with the finger-tip; a solution of bicarbonate of potash, sometimes combined with a little of the iodide, applied on lint and guarded with oil silk, are all valuable remedies, if carefully and persistently employed. Their use may often make all the difference between slow distortion and gradual recovery of the limb.

Case XLIII.—Mr. J. P., aged sixty-five, sent for me April 3, 1864. He had been suffering from an attack of gout, which had kept him in bed twenty-five days. He had been subject to such attacks for the last fifteen or twenty years; they had recurred since four years ago much more frequently. I found that in the present illness he had been treated by purga-

tives and colchicum—the latter injudiciously used, inasmuch as, the disease not yielding, more and more had been given, and at the time of my first visit he was taking six drachms of wine of colchicum a day, and at the same time sherry, since he had become weak, was ordered. Both toes, both ankles and knees, the right wrist and left shoulder, were all affected, painful, thickened, and very tender.

The colchicum and the sherry were at once stopped, bicarbonate of potash and carbonate of ammonia ordered, and whiskey instead of sherry. After a few days manifest improvement commenced. One grain of quinine in pill twice a day. After five weeks he was able to go downstairs, and in four months he could attend to his business in the city, walking with two sticks. During the first year he took 10 grains of bicarbonate of potash and 3 of the iodide, with 8 minims of tincture of digitalis thrice a day, then the doses were rather diminished. In the second and third year I sent him to Harrogate for six weeks each time. But he managed himself with these medicines, and by means of passive movements and rubbing, the joints were greatly restored. The only gouty manifestation since 1866 was herpes and itching; but I saw him occasionally for some other troubles. Later, certain circumstances caused him greatly to regret complete impotence (want of erectile power), which he attributed entirely to the alkalies and digitalis; but as he was at that time seventy-seven, it is possible that a cause other than medicinal was to blame.

Case XLIV.—Mr. C., aged thirty-one, a robust man, had, eight months previously, his first attack of gout; had threatenings two days ago, which being worse this day, March 25, 1871, he sent for me. I treated him with slight purge and 20 minims of colchicum wine. Farinaceous diet, rest in bed, 10 minims of colchicum and alkalies and diuretics thrice a day; he was getting better, and I hoped the symptoms would pass. But on the morning of the 2d, being begged urgently to call, I found him very ill, with low, weak pulse, abdominal pains, and the foot inflamed, pitting, and of a venous color; he had, too, a very peculiar dusky hue, which even pervaded the conjunctivæ. I examined the mucous membrane of the mouth, and found the lead hue on the gums. On inquiry it appeared that on the night of the 31st, feeling the foot better, he hoped to expedite matters by the use of a cold lotion, and applied, what happened to be in the house, some diluted liquor plumbi, and kept it on till he was awoke with pain at 4 A.M. of the 2d, nearly thirty-two hours. This changed the character of his attack to atonic gout. He was treated with iodide of potass and tonics, with an occasional small dose of colchicum—but was very ill for some days, and the malady proved very obstinate.

CHAPTER VIII.

HYDARTHROSIS OR HYDROPS ARTICULI.

These terms denote simply that the affected joint contains an abnormal amount of watery, *i.e.*, non-puriform fluid; but when a condition derives its name from one markedly prominent symptom, it always happens that different forms of disease become confounded under one term. Thus a chronic accumulation of sero-synovial fluid, within an articular cavity, may be either a mere slow hypersecretion, or the relic of an acute serosynovitis —it may be an accompaniment, a sequela of a false cartilage—a consequence of the development of synovial fringes, with innumerable smaller or larger movable bodies (see Chapter IX.); or lastly, the commencement and early symptom of chronic rheumatic arthritis. These maladies all differ in many particulars, but one must not lose sight of the fact, that a simple hydrops, with no other change of the synovial membrane than hyperæmia, will, in the great majority of uncured cases, lead to hypertrophy of fringes—this to development of small mures articuli—and in many cases to arthritis deformans. Yet a simple hydrops leading to these results is very different to maladies commencing at once in the above organic changes, hypersecretion being a mere symptom. False bodies and arthritis deformans belong to other chapters of this work, but while now engaged in considering hydarthrosis as a primary malady or secondary to acute disease, we shall never be entirely able to lose sight of its correlations with the other two conditions, nor must we ignore the proneness of either forms of joint-dropsy to induce, or at least to be followed by considerable change of structures.

Case XLV.—Benjamin ———, aged seventeen, weak, emaciated, was brought to me by his mother, July 15, 1857, for a burn he had received by falling in a fit upon the fire. The boy's fits had got worse of late; he was of weak intellect, and getting still more so; he was also growing thinner, although his appetite was voracious; he had a very bad cough, and expectorated a great deal.

His mother showed me his right knee, which was much swollen. It appeared that two years before he had an accident to the knee, causing great pain and swelling, and he was taken to the Middlesex Hospital: the joint was well when he came out; but for the last fifteen months it had been enlarging; it did not appear to produce pain, but only caused him to walk with the knee a little more straight than the other. The burn was treated and the knee strapped; I was desirous, after a time, of injecting the joint, but the mother was not inclined to let him undergo any treatment. The boy constantly getting weaker, expectorated more, and had longer fits; and on the 5th or 6th of October, 1859, he died.

October 7, 1859.—I obtained permission to make a post-mortem examination, simply for the sake of seeing the state of the articulation.

During life the condition of that joint had been as follows: It was very much increased in size, simply by the presence of fluid in the cavity; the peri-articular tissues were not at all swollen; the fluid felt very near the finger; the chief tumefaction was at the front of the thigh, considerably above the point to which the synovial membrane ordinarily extends; the patella was pushed rather forward, away from the condyles of the femur, but not so much so as is the case in acute synovitis, with infinitely less accumulation of fluid; there was a little bulging of the joint on each side the ligamentum patellæ; there had been no pain, unless he attempted to flex the leg considerably, but the joint was rather stiff.

The skin was reflected carefully back from the front and sides of the lower part of the thigh: the muscles, namely, rectus and vasti, were seen pale and thin, particularly the two last; they seemed spread out, and their fibres separated; when the rectus was turned back the same was found to be the case with the crureus: these muscles were dissected as low as could be managed from the white glistening outer walls of the pouch that extended high up beneath them, and this was punctured in such manner as to prevent, as much as possible, any loss of the fluid; the sac was then opened up by turning back the patella; there was extreme redness and vascularity of the inner surface of the synovial membrane; this was most marked in the folds between the femur and the inter-articular cartilages, also at the sides of the patella, but there was one part in the subcrureal sac which was intensely congested: the folds first mentioned were very velvety in texture, owing to turgescence in the vessels, but the substance of the villi themselves did not seem much increased; the cartilages had lost their opal bluish sheen; had become dull, milky, and soft, so as to take the impress of the nail: upon the anterior crucial ligament was a little cyst containing serum, the size of a pea, very like a blister; there was no shred of false membrane upon the surfaces of the joint, or floating in the liquor. The fluid was eleven ounces in quantity, straw-colored, with some round spots like oil on the surface; it had lost all thready quality, but had still a lubricating feel; it was very like the fluid of hydrocele, and contained a good deal of albumen; under the microscope the bottom of some, left standing in a conical glass, showed a few round cells.

The textures around the joint were next examined; they were found thickened, white, and glistening; the increase was not by addition of crude unformed textures, but apparently by simply greater nutrition of the normal parts, that is to say, the growth was uniform: there was no distinction of old normal and new abnormal textures.

Case XLVI.—Benjamin W., aged forty, admitted under my care into Robertson Ward, April 12, 1878, with diseased knee-joint. The man had been treated in several Provincial and London hospitals with temporary benefit; but the knee was becoming more and more useless. The disease began in an almost painless general swelling, more than seven years ago. At the time of admission the joint was greatly swollen; fluctuating like a thick fluid; painful, with a continuous dull, heavy ache and sense of distention; starting-pains occasionally; the tibia could be moved on the femur in almost every abnormal direction. The knee measured 19½ inches against 14 on the sound side; the limb both above and below greatly emaciated.

April 25th.—At the man's very urgent petition, I amputated the limb at the lower third of the thigh. The man made a rapid recovery. The cavity of the joint contained only 3½ ounces of fluid. On turning up the patella and synovial membrane a peculiar change and increase in the tissue was found. Its section exhibited the yellow edge of a soft, pulpy mass, not unlike the

flesh of an over-ripe or boiled orange, saturated in the same fluid as that contained in the joint, and on which its color appeared chiefly to depend. In the substance of this hypertrophic tissue was found a number of minute loculi or spaces communicating more or less freely with one another, and containing the same fluid. The thickness of the tissue varied in different parts; in the subcrureal portion it was about 1½ inch thick, and nearly obliterated the cavity.[1] Its internal surface was warty, or might, in other words, be described as composed of a number of rounded irregular eminences or cones with their apices to the lumen, their bases to the periphery of the joint. This whole mass was surrounded by a white, dense, tendon-like capsule, thicker in certain parts than others; there were no external ligaments save this thickened tissue. The crucial ligaments were sodden, softened, and much lengthened or loose. The fibro-cartilages remained, but they also were sodden, yellow, full of loculi, and in parts merged into the general hypertrophied mass. The cartilages were entire, but had become visibly fibrous over a great portion of the surface. Microscopic examinations were made in various ways of the hypertrophied mass. It consisted chiefly of an areolar tissue, composed almost entirely of yellow elements, wide-meshed, and scattered with cells and connective-tissue corpuscles distributed freely among them. White elements were rare, especially in the layers next the cavity, while in tracing the tissue outward the wavy fibres became more abundant. Yet there was no gradual transition from the tissue consisting merely of yellow and that of the capsule formed entirely by white elements. The loculi seemed simply enlarged tissue-spaces; they were lined irregularly and patchwise by endothelium, and were of every variety of size, from that of a slightly exaggerated connective-tissue interspace to that which would hold a No. 4 shot. There were but two bodies, which might be regarded as hypertrophied fringes—these were one the size of a horse-bean, the other rather larger, each attached by a thin pedicle to an apex of one of the conical projections above mentioned. They consisted of a more scattered and loose areolar tissue than the rest of the hypertrophied synovial membrane, and were soaked in the same yellow fluid.

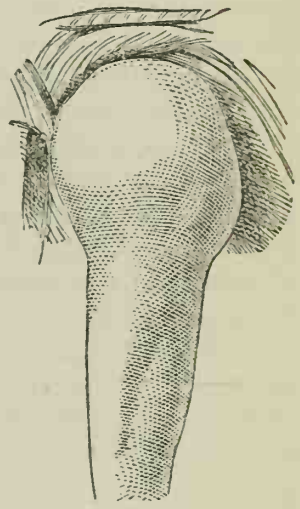

FIG. 17. — Hydarthrus of knee. (B. W.)

CASE XLVII.—George M., aged thirty-two, died in Charing Cross Hospital, March 18, 1873, of cancer of the pylorus. During his lifetime I had been asked by my late colleague, Dr. Headland, to examine his left knee. I found the joint greatly enlarged; the patella pushed forward; the skin rather tense; fluctuation was very distinct, almost as marked as in ascites. The subcrureal sac was more especially distended, and the popliteal space much filled up, while the parts on each side of the patella normally depressed were projecting. Measurement gave—

	Normal knee.	Diseased knee.
Above patella.....	13 inches.	17 inches.
Across "	13½ "	15⅞ "
Below "	11¼ "	12⅝ "

[1] In another more recent case, the same sort of tissue was only from ¼ to nearly ¾ inch thick.

Very remarkable was this tumefaction in conjunction with entire absence of inflammatory symptoms. The man was too ill to rise from his bed, but he assured me that when he had walked he suffered very little or no pain, but only from considerable weakness of the joint and of the limb. The disease had commenced about four years ago, when he fell and received a blow on the knee. He suffered the symptoms of acute synovitis, but continued his employment for four or five days; he then was obliged to lie up for more than a week. His knee got better, yet never regained its usual size or strength, and since then had gradually swollen to the above size, and had remained much the same for the last year and a half. Nine days after I had seen this patient he died of the pyloric disease and of marasmus, and I had an opportunity of examining the joint. The cavity was drained through a canula, 9½ ounces of fluid being withdrawn; after opening the joint 2½ ounces more were obtained. Some of this fluid, boiled in an evaporating saucer, became so solid that when the vessel was inverted only two or three drops flowed away: it contained, therefore, a large quantity of albumen. The mucin was in smaller proportion than the norm, for the liquor was not thready, though it still possessed the natural lubricating feel. A sample placed in a conical glass deposited in twenty-four hours an abundance of endothelial cells and leucocytes, exudation corpuscles, a few lumps of gelatinous concreta, and several shreds, which were probably broken portions of hypertrophied fringes.

The inner or free surface of the synovial membrane was greatly congested, of a darkish purple hue, and was very rough, exhibiting in parts a surface not unlike lichen, while in other portions the enlarged ends were clubbed; the nodules, of the consistency of bladders, containing fluid—in one or two instances soft, gelatinous conglomata of cells and nuclei or of oil. The accompanying sketch of a piece laid in water was made. This form of roughness was marked along the cartilage-zone, especially of the inner tibial tuberosity, but was most evident above the patella, and in that part of the subcrureal sac where the membrane reflected from the bone forms the end or *cul* of the sac. At this point was a shred of new membrane, irregularly oval in shape, ⅜ of an inch long, and in its broadest part not quite ½ inch wide. It was thickest about two-thirds of its length from the narrowest end, namely, about $\frac{3}{16}$ of an inch, and at this part over a surface 3 lines in length and 2 in width. It was organically united to the synovial structure, two or three vessels passing into it immediately breaking up into a leash of twigs and becoming lost in its structure. The rest was loose, consisting of very lax fibrous tissue containing a jelly-like substance, composed of corpuscles united together by structureless material. Surrounding the whole synovial membrane was a dense, white tendon. The structure very hard, and so resisting that the opened and emptied cavity did not collapse, but remained patent and gaping. The section edge at different parts showed this white material to be of very variable thickness. It was lined with the thickened synovial structure, of a yellow color, in places lighter, in places darker in hue, and of a gelatinous consistence, varying from ⅛ to ¼ inch, and soaked in the same fluid as filled the cavity of the joint. Microscopic examination of the tendon-like structure showed it to

FIG. 18.—Hypertrophied fringes seen under water.

consist of condensed areolar tissue, almost entirely of the white elements. The jelly-like substance was composed chiefly of yellow fibrous tissue, wide-meshed, rarefied rather than condensed; the interlacements exhibiting plentiful connective-tissue corpuscles, the interstices crowded with cells.

These cases have been selected from others, as showing well the state of parts in different instances. Cases XLV. and XLVI. are of the same form of disease, the one only older and more developed than the other. Case XLVII. is of a somewhat different variety, related, though perhaps only distantly, to a malady (multiple false bodies) to be described in the sequel.

The former more passive form of disease usually follows an acute synovitis, especially if the primary attack occur in persons whose debilitated constitutions do not permit the vessels distended, by inflammatory acts, to recover their tone. Nevertheless, it must not be supposed that even this most passive accumulation of fluid is due to mere exudation, such as occurs in œdema or in hepatic ascites. It is to be remarked that passive œdema, however largely it may affect the areolar tissues, spares the joints. Femoral, or ilio-femoral aneurism, frequently produces, by pressure on the neighboring vein, œdema of the thigh and leg; yet, although I have carefully looked for hydarthrosis in every such case that I have seen, that articular complication has never been present. Again, the fluid of dropsy, properly so-called, is entirely different to that of hydarthrosis; this latter contains a great deal more albumen in which it resembles the fluid of hydrocele. Mucin, though in smaller relative proportion than in normal synovia, is also present, which differentiates it from hydrocele liquor; a brownish hue of more or less intensity is usual in the fluid of such cases as have commenced in an acute synovitis, especially if that primary attack have been traumatic (blood-staining).

A point well deserving attention is the presence of a fibrinous concretion, adhering by a small part of its area to the synovial membrane; a condition which, though not constant, is very frequent in hydarthrosis, and more particularly I have reason [1] to believe in cases commencing in acute disease. As we shall see immediately, the primarily chronic hydrops articuli exhibits either no inflammatory symptoms, or such slight ones that any idea of a fibrinous exudation may probably be excluded, while such action is a not unfrequent accompaniment of acute synovitis; the effused fibrin may either remain on the membrane, or, becoming at first mingled with the ordinary joint fluid, may afterward consolidate, and by subsidence attach itself to some portion of the synovial surface (see p. 31). In these circumstances is contained the explanation of a great difficulty we occasionally encounter in procuring entire resolution of an acute synovitic effusion, even after inflammatory symptoms have been subdued; also of a residual pain and tenderness distinctly localized in certain unusual and in different cases varying spots. Here too lies the etiology of a slowly increasing dropsy of the joint, which occasionally begins to affect patients even months after an acute synovitis has been apparently cured. This view gains additional support from the fact that the presence of a loose body, even a mere soft lipoma, always produces, after a time, even if it cause no inflammation, a dropsical condition of the joint.

The form of hydarthrus, which commences without previous or accompanying inflammation, and is not attended by any marked change of struc-

[1] See an examination by Bonnet, Maladies des articulations, tome i., p. 430.

ture, villous proliferation or the production of false bodies, is of so extremely difficult etiology that I would rather not speculate on its causes, but will be content with the facts that it does not arise like œdema from venous pressure, that it is not intimately connected with rheumatic or other constitutional diathesis, and is therefore mon-articular, although I have observed in cases of long standing a tendency of the same joint on the other side to participate.

The form of hydarthrosis connected with dendritic growth and production of false bodies is so far discussed in Chapter IX. that only a few words are here necessary, more especially since the mere presence of more or less fluid is in such cases of secondary importance. Primary chronic dendritic fringe hypertrophy is one of the appearances met with in arthritis deformans, and this fact has led to the idea that hydarthrosis with such growth is always the commencement of that most obstinate malady. I believe this to be an entirely false notion, although doubtless many cases of arthritis deformans have in their earlier stages impressed the surgeon as synovitis, with dropsy, etc., before exhibiting their true character. The sort of malady now under consideration is generally connected with the rheumatic diathesis, is almost confined to the knee, occasionally attacks the elbow, and is most common with persons whose avocations oblige them to work on the knees, and to expose those joints to cold and damp. It is of more inflammatory origin than the simple form, is more painful, and leads more quickly, *i.e.*, without the presence of so much fluid, to uselessness, or greatly restricted usefulness of the joint. The bodies, which the tuft ends enclose, are, occasionally, merely lipomatous, the fat, kept warm in the joint-cavity, has the consistence of oil. The bodies themselves, if extracted during life, look like oil-drops enclosed in a translucent capsule, indeed, this is what they really are; but exposed to the cooler air, the fat consolidates, and the little bodies harden slightly—of such there may be hundreds in a single joint,[1]—varying from the size of a mustard-seed to that of a black currant. Closely connected with this condition, is the presence of innumerable small, almost transparent, floating motes, looking like pieces of jelly. They are common in the dropsy of tendinous sheaths, less so in joints, and are formed by pullulation of those secondary sacculi of the fringes previously described (p. 12), which thus enlarged break from their fragile connection. Sometimes, however, the fringe ends contain nodules of cartilage, even of bone, a condition which places the malady in another category.

In either form of the disease, plates of cartilage or of fibro-cartilage are occasionally developed in the thickness of the hypertrophied subsynovial tissue. When of the latter material they enclose in wide meshes a good deal of fat; when of the former they sometimes become ossified: they are of the structure described in Chapter IX., and are probably formed in the same way.

These changes are associated with a commensurate hypertrophy of the peri-synovial tissues, which become thickened and condensed into a tendon-like or ligamentous material, simulating in places fibro-cartilage; indeed, but this is more common in the cases combined with fringe hypertrophy and the formation of false bodies, plates of true cartilage may form a part of the abnormal wall. This enlargement is in simple hydarthrus due to the mechanical force of greatly augmented fluid, and to the hyperplasia following increased strain necessary to resist its pressure. In the latter

[1] Compare (Chapter XVII.) the melon-seed or hydatiform bodies found in inflamed tendinous sheaths.

more constitutional variety, vice of diathesis, probably the rheumatic, is intimately concerned in the morbid irritation.

From the mechanical action of the excessive fluid result also elongation and stretching of the ligaments, which cause such relaxation of the joint, that hereon its useless condition in very great part depends. A knee which has been long thus diseased may be bent sideways, or the tibia may be rotated on the femur, a sixth of the circle to the right and left; also—and this is of diagnostic value—the lower bone may be moved laterally on the condyles a considerable distance, generally with a smooth, *i.e.*, non-crepitating, motion.

After an interval, greater in the simple, smaller in the dendritic form of disease, the cartilages undergo fibrillation. At first, they simply lose their opalescence, become striated, the corpuscles slowly break up, fatty degeneration of the cells sets in, and then the hyaline structure splits into fibres (like velvet pile), some of which loosen themselves from the articular lamella, and are floated away by the joint fluid. In one case that I examined, the whole structure had become very thin, and fibrillation appeared only in a few spots, but this was in the person of a man, aged seventy-eight, and the appearance was probably not entirely due to disease.

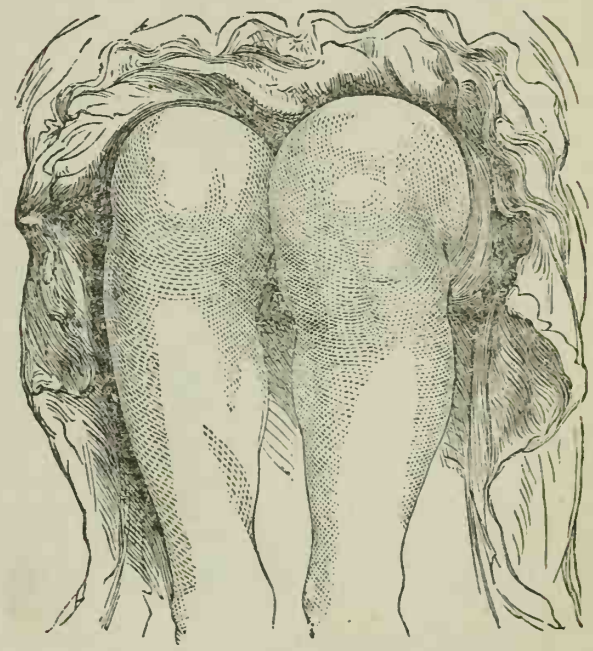

FIG. 19. — Hydarthrus (enlargement of subcrureal pouch).

Occasionally, though rarely, in connection with joints thus diseased, cysts are formed, or at least are distended, in its immediate neighborhood; they are most commonly found in the popliteal space, or upper and inner part of the calf, and are formed by protrusion, a sort of hernia of the synovial membrane through one of the apertures of the posterior ligament. Such occurrence is most likely to take place in very slow gradual distention of the membrane, but may also arise in less chronic maladies, and of course is more likely to take place if the patient be kept on his back. The protrusion having once been formed will go on increasing, even though the joint-effusion diminish and disappear. The process by which such hernia-like cysts are formed is precisely similar to one mode of the production of ganglia from a joint or tendinous sheath, and in the same way the connecting tube between the new cavity and the normal one may be obliterated. All surgeons should be aware that such cysts about the popliteal space, or upper part of the leg, may communicate with the interior of the knee-joint, since, if taken for an abscess and opened to the air, the gravest results may follow.[1]

Symptoms.—The especial characteristic of hydarthrus is the presence of a large fluid swelling within the cavity of the joint, combined with the ab-

[1] See Chapter XVII. and an excellent paper by Mr. Morrant Baker in the St. Bartholomew's Hospital Reports, vol. xiii.

sence of any inflammatory symptoms. There only remains then, the non-existence of these latter being distinctly recognized, to ascertain with accuracy the fact that the swelling is due to fluid, and that the fluid is within the joint-cavity. The symptoms of liquid in different articulations have been given with sufficient minuteness (Chapter II.); the great quantity of effusion in this disease renders its diagnosis only more easy. Yet the form of the swelling itself differs somewhat from that of an acute synovitis, inasmuch as the slower accumulation endows it with greater power of distending and enlarging those parts of the joint-sac which are least supported by ligamentous or other firm bands; the joint therefore assumes an uneven and "nubbly" aspect.

Thus at the knee, the parts at each side of the ligamentum patellæ project in a very conspicuous manner; while—and this is a marked diagnostic sign—the subcrureal pouch of the membrane is more particularly enlarged, being not only protuberant but encroaching abnormally far up the femur. By pressing, while the knee is straight, on this pouch, with the flat hand, one may force the fluid from it into other parts, for instance, into the already distended portions by the side of the patellar ligament, which then visibly increase, and again when the hand is removed diminish. Thus the surgeon may actually make fluctuation visible. The peculiar symptom which I have named knocking of the patella is in these cases very plainly marked. In most cases the popliteal space is almost obliterated, more rarely it becomes —and of course only when ligaments are yielding to the internal pressure— an absolute swelling.

At the elbow, where the disease is next in frequency to the knee, the swelling is chiefly over the internal condyle, but it also runs up the back of the arm, pushing backward the triceps tendon, and forming on each side of it a large cushion-like swelling. In cases of long standing, the sigmoid notch of the ulna becomes slightly separated from the condyles of the humerus, and there will arise that knocking or elasticity of the olecranon which I have denied to be a usual symptom either of acute or of strumous synovitis. This condition of joint is accompanied by a certain amount of stiffness, often also by a dull sense of distention and weight. The stiffness seems due to two causes: to increased tension of the capsule, and to the fact that the limb naturally seeks that position, which allows most room to the fluid.

Hydarthrosis of the shoulder-joint is rare. A case which I studied with care exhibited the following peculiarities thirteen months after pain and weakness of the limb were first observed. The arm hung by the side from the shoulder to the elbow; this latter joint was bent at a right angle, and if the hand was not supported in a sling or on a table the patient held it in the other, as a depending posture caused pain about the front of the shoulder. The joint was greatly enlarged, so that the acromion formed a depression at the top of the swelling. The enlargement was divided into three parts by broad, shallow sulci; one corresponding to the anterior, the other to the posterior axillary fold. The chief enlargement was outside the arm and under the deltoid; but the axilla was nearly completely filled up and the swelling encroached behind on the scapula, half the length of the infraspinous fossa. Measurement with a pair of long callipers showed the arm to be ½ inch longer than the other; this was produced by relaxation of the ligaments and of the deltoid, which allowed the limb to drop; for on holding the arm about the middle and moving it briskly upward I could cause the head of the humerus to tap against the glenoid cavity and produce a sense exactly like "the knocking of the patella." The patient had almost com-

pletely lost the power of raising the arm from the side; he could bring it a little forward and in front of the chest, and had more power to place it behind. The pain was not severe, but was a constant, dull, heavy aching. Fluctuation was markedly evident throughout.[1]

It is hardly necessary to describe here the peculiar shape of the enlargement produced by this disease at other joints, since it is, until the ligaments are almost destroyed, very similar to that produced by acute or subacute sero-synovitis.

When the malady is of old standing, and the secretion in the joint is excessive, the ligaments become so stretched as to be of little or no use as bonds between the bones. In the worst cases they may be simply spread out, and merged into that inflated white structure which surrounds the joint, and is formed by metamorphosis from the peri-synovial tissue. Hence result looseness and flaccidity of joint, rendering the limb almost valueless, as in a case under the care of my friend Mr. Bellamy, in which the tibia was movable in all directions on the femur.

Thus the mere diagnosis of large fluid-accumulation in a joint which is not, to say the least, the subject of acute, nor indeed of subacute, inflammation, presents no difficulties. But we have, under the name hydarthrus, to do with different forms of disease having this one condition, fluid distention of the joint-sac, in common. Now in some of those forms that distention is a mere adjunct to more profound changes; in others, it is the chief and primary evil. The diagnosis, to be of any value as the foundation of prognosis and treatment, must distinguish these varieties of disease. Occasionally, we see cases so early, that this task is very easy, the facility depending on the comparatively small amount of effusion, which enables the touch to distinguish the presence of hypertrophied fringes, even though not largely developed. They are most easily detected by placing two or three finger-tips on a part of the synovial membrane, which is most superficial as well as considerably distended, making sufficient deep pressure to bring its inner surface in contact with the underlying bone, and then to move the whole mass of the soft parts up and down upon the hard substratum. Under such manipulation hypertrophied fringes, roughening the inner synovial surface, impart to the hand a rustling sensation, which, if we may use terms applicable to the ear as descriptive of tactile impressions, we may call a *bruit parcheminé*. I have long ago compared it to the sensation produced by rubbing between the fingers two surfaces of a silk ribbon, calling it in my class "silken crepitus." A fine silk will represent but slight hypertrophy, a rougher one more considerable enlargement, a ribbed ribbon will simulate a nodulated dendritic growth. In some cases, if the joint be superficial, we may even make out grains or knots movable within certain limits; these are the nodules of enlarged fringes. Occasionally, on examining a joint, the hands making the tide of fluctuation pass from place to place, will feel not the wave merely, but the stream; a sense of movement, of progression is imparted to them. This is produced by the presence of those small detached solids or semi-solids already described (p. 170). I have indeed, after detecting this symptom pretty early, felt it in subsequent stages manifestly increase as the bodies augmented in number.

But if the joint be much distended, it becomes impossible to press the

[1] Some of these symptoms differ slightly from Mons. Roux's well-known case, "Mém de l'académie," tom. xiii. He founds on his observations some distinctions between hydarthrosis of ball and socket, and of hinge-joints, saying that in the former but not in the latter, neighboring prolongations of synovial membrane participate. As we have just seen, however, the same occurs at the knee.

synovial membrane sufficiently against the bone to produce the silken crepitus; hence inability to procure such evidence must not cause us to conclude on the absence of enlarged fringes. Before any judgment on this point can be formed, the cavity must be emptied, partially or entirely, when the silken crepitus, previously absent, will, if the villi be hypertrophic, appear.

The evacuated fluid should also be utilized to assist our judgment. The presence of melon-seed bodies, a very thick, almost viscous fluid, with large concreta, and if a full-sized canula have been used, perhaps a detached nodule or two, indicate considerable changes. A fluid, rather thinner than synovia, pale and yellow, denotes but slight changes. In all kinds of the liquor, but chiefly in the viscid, a plentiful deposit of cells is rather indicative of extensive morbid alterations. But another condition, namely, the existence of fibrous or fibro-cartilaginous plates in the peri-synovial tissues, may generally be best and most clearly made out, while the joint is still considerably distended and semi-tense, they present themselves to the erudite touch as more or less rounded or flattened projections floating on the subjacent fluid; they can be depressed inward toward the cavity, but not moved from side to side. They dance, therefore, on the fluid, whose fluctuation can be felt through them, dulled more or less according to the thickness and resistance of these plates.

Evident and rough silken crepitus, presence of nodules and of cartilaginous peri-synovial plates, indicate some other form of disease than simple joint-dropsy. Perhaps the condition will tend to the formation of multiple false bodies with persistent distention of the joint. Or, again, this condition of synovial membrane may be only the first phase of arthritis deformans. To make this distinction the surgeon must very fully study the shape of the bone-ends, and ascertain the presence or absence of osteophytes and of bony crepitus.

The prognosis must depend on the class of case, on the antiquity of the disease, and on the constitution of the patient. Simple hydarthrosis, with but little change of synovial tissue, may be overcome, and the joint restored to fair usefulness, if the ligaments be not too much relaxed. Great distention of those parts is a serious obstacle to cure, and a greatly loosened joint can only become restored, if ever, after a considerable time.

When considerable change of structure has taken place, less favorable results are usually obtained; yet, if the fringe hypertrophy result only in the production of small tufts and small lipomatous false bodies, a useful joint may yet be secured. Larger and many bodies, with fibrous or cartilaginous peri-synovial plates, indicate a less favorable—greatly enlarged and roughened bones the most unfavorable—state of affairs.

Treatment.—After an attack of acute synovitis, simple surplus of fluid in a joint-cavity may be either merely the relic of a past, or may be the commencement of a future disease. If the former, it will either remain stationary, or will decrease; if the latter, the contrary event will occur. A strong opinion was expressed (p. 35) that if the effusion of an acute synovitis be evacuated and not too late in the disease, subsequent weakness of the joint, enlargement of the synovial cavity, and, *a fortiori*, the tendency to hydarthrus, are to a very large extent avoided. We may go further; if, after the inflammatory phase of acute synovitis has entirely ceased, there yet remain a considerable amount of fluid in the joint, its very presence will tend to injurious distention. On the surgeon's judgment, as to whether the effusion is becoming, or is capable of being absorbed, will depend his choice whether he will use further remedies, both general and local.

We must, in using the former, be careful clearly to formulate to ourselves what we aim at, and what it may be possible to do. A physician may, in many cases of œdema about the lower limbs, decrease, even entirely eliminate, the fluid effusion by means of purges and diuretics, mercury, etc. We shall never succeed in doing this for a hydarthrus, it is not œdema, and does not arise in the same way, nor from like causes; we might, therefore, almost drain from the rest of the body all fluids, and yet the joint-bag—since deficiency of excretion has nothing to do with the disease—would remain full. One should, therefore, promote neither purging nor diuresis, on the mere chance of getting some of the synovial fluid absorbed, unless the alvine or renal functions be faulty.

On the other hand, if there be reason to believe in a rheumatic condition, iodide of potass, James's powder, ipecacuanha, guaiacum—probably also salicine or its derivatives—may be prescribed. Antimony was forty years ago much lauded by M. Gemelle, and had a certain vogue.[1] I reported indeed a case cured by that medicine, in combination, be it remarked, with local measures, but the remedy has not maintained its reputation, and to keep a patient nauseated for nearly a fortnight is severe treatment, unless cure of the disease were certain.

The *Local Remedies* are manifold. Rest, especially if the patient have previously been walking about freely, causes almost always a certain diminution in the size of the tumor. Strong rubbing *upward* is often of considerable assistance, and pressure firmly applied has more than once in my hands proved curative. The best method of using it is by means of elastic webbing tightly bandaged over the joint, while the part below is supported, to prevent swelling, by an ordinary linen or cotton roller. Blisters, iodine paint, strong stimulating lotions, have all been used, with occasional advantage. The iodide of lead and potass ointment may also be useful. Mercury in any form appears to be injurious. It must be observed of all these applications that while the patient is in bed they seem to do good, the swelling may diminish, or almost disappear; but when the patient gets about again, hypersecretion is very apt to recommence; the old disease to reappear. The best means of preventing recurrence is pressure, but even this will sometimes fail.

While we may thus cure a case of rather slight hydarthrus of not too old a date, we can hardly hope by the above means to overcome the disease if it be more severe. Such cases, and indeed slight recent attacks, if not rapidly yielding, should be more efficaciously dealt with, lest worse follow.

Puncture of the Joint, and evacuation of the fluid, will, at all events for the time, diminish the tumor, and enable pressure to act more directly on the membrane. The surgeon should seize the opportunity of making the thorough examination already recommended (p. 173), then the compressing bandage should be applied at once. It will certainly cause a fresh flow through the puncture-wound, even though very valvular; hence that part should be covered last, and the protective material, a piece of carbolized oil-silk is the best, merely laid on beneath the last turn of the bandage. The sort of fluid withdrawn should be carefully examined, with a view to guide more accurate diagnosis.

If these means fail, and if absence of false bodies and osteophytes have

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[1] Mémoires de l'académie, July, 1840. Mons. Gemelle began with half-grain doses every three hours, increasing them till they amounted to twelve grains in the twenty-four hours, the medication being continued about twelve days.

been verified, the joint may be injected with iodine. To do this a trocar, with a canula whose perfect fit upon the nozzle of a syringe has been tested, is introduced into the articulation; all the fluid is evacuated, pressure by the hand in different directions ensuring as complete emptiness of the joint as possible. The syringe, previously filled with the solution (one or even two drachms of tincture of iodine to the ounce of water), is adapted, and the fluid injected. For the knee, from four to six, for the elbow or shoulder about two ounces, usually suffices; but if distention have been considerable, double these quantities may be necessary; indeed, I prefer to try and inject as much fluid as has previously been drawn off. When enough of the solution has been passed in, the syringe withdrawn, and the canula mouth occluded (a short piece of wax urethral bougie is the most convenient plug), the joint should be kneaded with the hand, placed in various positions, the limb raised, depressed, turned, etc., until one is sure that every point of the membrane has been washed by the injection; then the limb is to be so placed, that the canula lies at the most dependent part, and all the fluid is to be withdrawn. It is impossible to state any definite time during which the injection is to remain in the joint-sac. In my experience, between two and six minutes is sufficient to produce that sense of heat in the joint, with slight aching up the limb, which must be the signal for the withdrawal.

Subcutaneous incision of the membrane is in this disease, as in acute synovitis, often valuable. It is performed in the way described at p. 37. The method was first introduced by M. Goyrand: it is simple, all but painless, and in uncomplicated cases fairly successful. The incision should, however, be wide; indeed I prefer two, opposite each other, on either sides of the joint. When, in two days, all the fluid has left the synovial cavity, and infiltrated the neighboring parts, firm pressure should be used, and some endeavor be made, if the tumefaction have been considerable, to fold one edge of the synovial incisions over the other, and thus at once restrict the size of the sac. The method is founded on treatment of the most prominent symptom, yet is successful when only slight changes of the synovial membrane have taken place.[1]

Free Incision into the joint could not, some few years ago, have been too strongly condemned; but since the introduction of antisepticism a different view must be taken. I have cured more than one obstinate hydarthrus, with several fringe hypertrophies, by this means, namely, a sufficiently wide incision to permit all the fluid to come away at once. If pendulous fringes exist, and the place of incision have been well chosen, one or more of these will float out and may be removed. The joint may then be squeezed and kneaded in the hands, when more nodules will probably appear. If so, the finger, previously dipped in carbolic acid solution, may be carefully introduced, any soft false body that may be felt drawn to the surface or broken away, and allowed to flow out. India-rubber tubing may be then oiled (carbolized oil), passed well into the cavity, and with a large syringe a strong stream injected. Such treatment, apparently very heroic, is by no means dangerous, and is very efficacious. Of course the wound must be dressed antiseptically, and the limb, for about three weeks, placed on a splint, which can be arranged at different angles.

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[1] M. Bonnet's Maladies des articulations, tome i., p. 434, relates a curious instance of rupture of the distended synovial membrane by a fall, whereby a hydarthrus of some standing was at once cured.

Case XLVIII.—Susan B., aged forty-eight, came among my out-patients at the Charing Cross Hospital, April 13, 1860, with a swollen knee.

The right knee had been painful for about a week; the pain had come on at night; it was somewhat swollen: the tumor was fluctuating; the patella not in contact with the femoral condyles: slight stiffness, no tenderness, heat, nor redness; she was subject to rheumatic pains, chiefly in the right shoulder, and attributed the pain in the knee to rheumatism; she is strong and stout: knee to be strapped.

She was ordered half a grain of tartrated antimony with nitric ether three times a day.

April 17th.—Knee perhaps a little smaller: reapply strapping.

April 24th.—The knee is certainly better; the swelling had much decreased: knee to be strapped with the emplastrum ammoniaci.

May 5th.—The medicine produced some feverish symptoms and diarrhœa. To be discontinued; some Dover's powder and an alkaline mixture were ordered.

May 12th.—The diarrhœa and feverish symptoms subsided; the knee had quite regained its shape; there was a little thickening above the patella: to be strapped again with the same plaster. Ordered to take two grains of quinine, in the form of pill, three times a day.

May 19th.—Discharged; cured. Ordered to keep the knee strapped.

This patient returned to me more than four years (May 7, 1864) after her discharge, with a return of the swelling, but very considerably exaggerated. She told me that the cure which I had effected had only lasted about three months, and that then the knee began slightly to swell again. She often had to be at home in hospital or infirmaries, she now wished the leg to be removed. I proposed first to use some other means.

May 14th.—Tapped knee—drew off nine ounces of a rather thin, straw-colored synovia—injected nine ounces of solution of iodine, two ounces in pint, after four minutes she felt some pain up the thigh—only a little more than eight ounces of the fluid came away, no more in any position of the limb would flow. Joint enveloped in elastic web bandage and placed on a MacIntyre splint.

May 16th.—Had some pain, which indeed on the night of the operation was rather severe, but she slept pretty well; knee rather swollen—puffy.

May 20th.—No pain, except at night. On trying to move joint some pain was caused, and there was some stiffness.

May 28th.—Pressure, rubbing and passive movement were used. Since the last report the knee seemed quite well, save slight restriction of movement.

I saw this patient three years after the operation, the knee was still quite well, and she said as strong as the other.

Case XLIX.—Elizabeth Grant, aged twenty-eight, a tall woman with powerfully formed limbs, came among my out-patients to the Charing Cross Hospital, January 8, 1858, for an enlargement of the right knee.

Six months ago, in doing some household work, she knelt upon a thimble and hurt her knee. It was painful and swollen for three weeks; she rested as much as she could, but underwent no treatment: at the end of that period both the swelling and pain disappeared, and she took no further notice of the occurrence; but, ten days ago, the joint began to swell again and to be painful. She had been suckling up to the above date: the child being fourteen months old.

The knee was very considerably swollen, presenting a baggy tumefaction, concealing the shape of the bones, and larger in some places than

others; one of these was in the lower part of the joint on either side of the ligamentum patellæ; but the chief enlargement was on each side of the rectus muscle. The measurements are:

	Sound.	Morbid.
Above patella.....	15¼ inches.	17½ inches.
Across "	15¼ "	17 "
Below "	13⅞ "	15¼ "

The tumor was fluctuating; waves of fluid could be made to pass from one part of the joint to the other; there was some appreciable thickening of the peri-articular tissues; the joint was neither tender, hot, nor red; she had very little pain, but some stiffness; she could in the morning walk without any limping, but in the evening, and when she had been about a good deal, she had a sensation of "bursting" in the joint, increased stiffness, and was obliged to limp.

I ordered her to wean her child: to have a gutta-percha splint bound to the back of the joint; a blister across lower part of the femur, three grains of iodide of potass.

January 13th.—She said that she was obliged to do her work; the splint prevented this, and therefore she took it off: there was no improvement: blister to lower part of joint.

January 18th.—She was no better: I persuaded her to come into the house, and Mr. Canton kindly allowed her to remain under my care. Repeat the blister above the joint, and let it be kept open with iodide of potass ointment: bed.

January 27th.—She was not at all improved: let the blister heal.

February 3d.—The blister having healed I passed a narrow tenotome into the joint, about an inch and a half above the outer edge of the patella, and sweeping the blade upward, divided the synovial membrane to an extent of about an inch and a half to two inches, and bandaged the knee tightly from below upward.

February 5th.—She was in no pain: the bandage was quite loose; when it was removed the joint was found reduced; there was still a good deal of swelling, but it was diffused and did not fluctuate: bandage reapplied. To take quinine and iron.

February 12th.—The knee was strapped three days ago; she was in no pain; allowed to get up.

February 23d.—There was no appearance of return, but the knee has been kept strapped; discharged.

I saw this patient, casually, on April 8, 1859; she had had no return of swelling, and had no inconvenience with the knee.

Case L.—James F., aged forty-nine, came under my care into Charing Cross Hospital with a hydarthrosis of the left knee, May 6, 1875. I treated him with subcutaneous incision without result. I injected the joint with iodine, but with only temporary benefit. He had been discharged, but returned, for as soon as the man got about again the disease returned.

January 5, 1876.—Under chloroform narcosis I made a free incision, observing all antiseptic precautions, into the joint on the inner side. As far as could be estimated about ten ounces of opalescent fluid, containing many melon-seed bodies and glomeruli, came away. Passing my finger in I found a rough hirsute inner surface to the membrane. Injected the cavity with a three per cent. solution of carbolic acid, placed a drainage-tube in the lips of the wound, so that its end should just project within

the synovial cavity—dressed him antiseptically, and placed the limb on a splint.

January 8th.—No temperature or other bad symptom. A great quantity of fluid flowed constantly away, necessitating the introduction of a mass of tenax under the last turn of the roller.

February 8th.—There had been no bad symptom. I directed the splint to be removed twice in the week and the joint moved; it produced no pain unless the motion were carried beyond a certain point; the arc was much restricted. The discharge of fluid had gradually decreased, and was at the above date very slight; pressure with an elastic bandage since first of the month.

March 8th.—The wound healed entirely. About February 26th, the joint was greatly decreased in size; some silken crepitus could be detected. Discharged, with orders to keep up pressure. The limb could not be quite straightened, and only flexed to about an angle of 130°, but was quite available for all ordinary uses.

CHAPTER IX.

ON MOVABLE BODIES IN JOINTS.

The presence within the joints of movable loose bodies has been only known to surgeons since the time of Ambrose Paré, who, in the year 1558, opened an "aposthume" in the knee-joint of a barber, and evacuated with the fluid a loose cartilage. Since his time the bodies have been known by the name "loose cartilage," but inasmuch as movable bodies in joints may also be either bony, fibrinous, or lipomatous, it will be well to avoid any term for the general malady that shall denote a structure in itself so various. The essential of the condition, considered clinically and simply stated, is that the joint-cavity contains one or more movable masses of variable size, which often give rise to troublesome symptoms. Such body may be either cartilaginous, osseous, or a mixture of the two, fibrous or fibromatous, mere lipomatous growths, or may in part be made up of a foreign substance introduced from without. The cartilage, unless the movable substance have once formed a normal portion of the joint, is not, like articular cartilage, provided with corpuscles; the characteristic cells, often very few in number, are simply scattered irregularly through the substance. Sometimes the centre of such body consists of a yellow, thick jelly, like inspissated synovia. Neither does the bony loose body consist of regularly formed bone with its various anatomical constituents. Certain of those which have been examined were possessed of well-formed lacunæ with canaliculæ; others of abortive lacunæ, without those appendages; Haversian canals are always absent. More commonly the structure is not osseous at all, but a mere amorphous or granular mass of lime-salts. When the body is a mixture of some such bone and of cartilage, the greatest variety in their relative position obtains; the one or the other may form the circumference or centre of the globular or ovoid shape. In the plate-like variety the one surface may be cartilage, the other osseous, or the two kinds of structure may be irregularly intermixed or tesselated; occasionally the one may permeate the other in an arborescent manner.

These bodies are often multiple. I have removed three from one knee-joint (see Case LIV.), and have seen in an elbow a number which I should compute at between thirty and forty (see Case LI.). Mr. Berry, of Kentucky, is stated by Pirrie[1] to have removed from the knee of a negro thirty-eight such bodies; moreover, very small fatty nodules at the end of hypertrophied fringes may be innumerable.

In size they vary from the scarcely visible to the bigness of a horse-chestnut, or even larger. In shape they have a tendency to four forms: 1. Oval or circular plates, either bi-concave, concavo-convex, or bi-convex. 2. Globular, oval, or chestnut-shaped. 3. Conglobate or mulberry. 4. Pyr-

[1] Principles and Practice of Surgery, third edition, p. 343.

iform. These two last forms are rare; the third shape is in part or entirely osseous; the last lipomatous.

The predilection of these bodies for the knee is remarkable. I should say that nine-tenths of the cases occur in that joint, next in order of frequency is the elbow. The hip becomes the habitat only, I believe, in arthritis deformans; one is said to have been found in the temporo-maxillary articulation. Operative measures for the removal of such bodies have never, as far as I know, been resorted to at the hip, only occasionally at the elbow; far more often at the knee.

Although it would not be warrantable to assert that all false bodies in joints are due to the rheumatic diathesis, yet it is certain that many single ones (save the lipomatous), unless arising in injury, are most commonly found in persons of such constitution. The multiple ones, that is when the number is large, are very frequently connected with arthritis deformans, a malady generally ascribed to the rheumatic taint.

Since 1558, when Ambrose Paré first detected a movable body in the knee-joint, the mode of formation and growth of such substances lying free within a cavity has been the subject of much conjecture, and latterly of investigation; nor have opinions on the matter greatly coincided, as is only natural, seeing that in reality their genesis is even more various than their structure. This may be:

1. By hypertrophy and metamorphosis from one or more of the synovial fringes. 2. By histogenetic transformation of some spot or spots of the para-synovial tissue. 3. By growth from the periosteum at the edge of the articular cartilage. 4. By organization of a clot of fibrin or of blood effused within the joint. 5. By direct growth from the articular cartilage. 6. By detachment through injury of a piece of the normal joint.

The first of these methods of growth has been more particularly studied by Mr. G. Rainey, whose account, although he was wrong in supposing that this was the only mode of formation, I cannot do better than transcribe.

"These bodies have a distinct investing membrane, which on its external surface is smooth; but by its internal one is so intimately connected to the body itself as to admit of being detached only by small shreds.

"This membrane is composed of fibro-cellular tissue mixed with granular matter.

"Their internal structure, as exhibited by a section through their middle, is seen by the naked eye to consist of two distinct substances—the one being semi-transparent, like fibro-cartilage, the other perfectly opaque and white, like bone. The former, under the microscope, presents the appearances usually seen in fibro-cartilage; the latter resembles remarkably in its ultimate structure those bones which consist only of one bony plate placed between two folds of membrane, as the thin plate of the ethmoid. In the bones, the lacunæ, as in the opaque parts of the bodies before mentioned, are the same as in other bones; but there are no distinct or well-formed canaliculi branching out of them. There is in both a stellate arrangement of the earthy matter around the lacunæ, but nothing like canaliculi, and this appearance is more striking in the bones alluded to than in the earthy parts of these bodies.

"I believe no satisfactory explanation has yet been given of the manner in which these bodies are formed in joints, although I think their origin, and the circumstances of their becoming loose in a joint, will appear obvious, by a reference to the remarkable character of the epithelium in joints; the thecæ of tendons and mucous bursæ."

Mr. Rainey then gives the description of synovial villi and their secondary sacculi, already quoted (p. 12), and goes on to say:

"Now, this being the apparatus by which synovia is elaborated in all parts, in which this fluid is found, and the bodies thus described being found in these situations, they may be inferred to be the product of disease in these structures; the cellules of these fringes, in the place of elaborating synovia from the blood, producing, under the influence of morbid action, other products, such as cartilage, which becomes converted into imperfectly formed bone. The fact of the secondary sacculi being connected to the primary by extremely narrow pediculi will suffice to explain the reason why these bodies may become formed in the first instance; the pedicle serving both to keep them attached, and to convey the material from the blood necessary for their development until they acquire a certain size; but afterward, from its tenuity being no longer capable of holding them, it breaks, and the bodies become loose and most likely cease to enlarge."[1]

The lipomatous bodies which I removed from the knee of Alice D. were formed simply by hypertrophy of an adipose tuft (see p. 193). Nevertheless, it will be evident that such growths might also arise in the second method, but without inflammatory antecedents.

The second method of growth is by direct metamorphosis of tissue. There are not a few conditions, traumatic and constitutional, which give rise to such changes in the immediate neighborhood of joints and elsewhere. Under the influence of a direct hyperplasia resulting from a blow, a punctured wound, or a certain dyscrasia, a nodule of fibrin is deposited in the fine tissue immediately underlying the basement-membrane. In this nodule a few cartilage-cells will be deposited, which, gradually gathering hyaline substance, and developing fresh cells, enlarge the original substance till it becomes a cartilaginous, perhaps an ossifying plate or menisc, which, pressing inward, causes the synovial membrane to bulge into the joint-space. Increasing in thickness, and exposed therefore to more and more outward pressure, it protrudes farther and farther until it quite intrudes, hanging by a broad fold—a sort of mesentery—upon the side of the cavity. It now comes within the influence of the joint movements, which, rolling it from place to place, pull upon and elongate this fold into a pedicle, which as it grows in length diminishes in thickness, until it at last gives way altogether. The plate which originated without has now become a free body within the joint.

The third mode of development is in its mechanism, similar, but the place of origin is different, namely, from the parts just outside the synovial basement where that tissue joins the periosteum. In certain conditions connected with the rheumatic diathesis with arthritis deformans, or with the form of injury which conduces to the malumcoxœ senile, there is a very strongly marked tendency to the production of osteophytes around and in the neighborhood of this place of transition. Those which lie nearest to the synovial membrane are very liable to be protruded into it as above described, when the mechanism of its further intrusion and liberation is identical.

We are indebted to John Hunter for our knowledge of the fourth species of loose body; they are, however, not very common. The formation of such substance from a fibrinous concretum or blood-clot within the joint can only arise after injury or after a rather acute synovitis, which, as already stated, may produce such deposit (p. 26). Probably only those clots which

[1] Pathological Transactions, vol. ii., 1848, pp. 110, 111, Mr. Rainey's examination of some false bodies from the elbow-joint exhibited by Mr. Solly.

are adherent can undergo the subsequent changes into cartilage or bone. The several false bodies which occasionally form after the extraction of a single one, in all probability owe their origin to an effusion of blood from the operation wound into the cavity, but they may also be produced by fringe-growth from the united but irritable synovial wound.

Direct growth of a tumor from the surface of an articular cartilage is a very rare event (ecchondrosis), its etiology entirely unknown. A certain number of cases are on record, in which, after death or amputation, loose bodies, the subject of operation, have been found to fit accurately into gaps left by their detachment in the normal articular cartilage,[1] while a loose body, apparently broken off from a meniscus of the knee, is also recorded (Broadhurst: "St. George's Hospital Reports," vol. ii.).

A few words about the correlations of these methods may here be said. The first mode of growth is more especially connected with that form of hydarthrosis in which a tuft-like growth renders the inner synovial surface dendritic, *i.e.*, covered with branching growths that project into the cavity; nevertheless single loose bodies doubtless originate from a hypertrophied fringe, the rest of the membrane being healthy, or nearly so; in no such case does any persistent effusion distend the capsule until the accidents to which these growths give rise have occurred two or three times. When such bodies arise, as a consequence of dendritic growth general to the synovial surface, be it connected with hydarthrosis or with arthritis deformans, they are multiple, like those in the Kentucky negro's knee, or in the sailor's elbow already mentioned.

We have seen (see Chapter VIII.) that several forms of hydarthrosis exist, that two of these are closely connected with the production of false bodies on the one hand, and with arthritis deformans on the other. It is very difficult—perhaps often impossible—to distinguish clearly those cases of multiple dendritic false bodies which are of chronic arthritic, and those which only are of synovitic origin. I do not think it correct to assume that this latter ever leads to or terminates in the former. When such mutation of disease appears to take place, the true explanation seems to be, that the case in question was from the first arthritis deformans; that the synovial condition being strongly marked made the deeper impression on the surgeon's mind, and concealed from him the more significant, deeper-lying but less patent affection. I certainly have seen and operated on cases of hydarthrosis with multiple false bodies, which have not led to the bony conditions of arthritis deformans—the operations resulting in cure or improvement. In examining a case of large joint-effusion with a number of false bodies, the surgeon must never lose sight of the fact that, underlying and producing this condition, there may possibly be a more important, and, as far as the joint-functions are concerned, a more serious malady. Much acumen and considerable acquaintance with articular disease will be required to guide him aright in his prognosis and choice of treatment.

The second mode of growth is connected with arthritis deformans, the third has often a similar relationship, but with a less pronounced form of the malady; and it may also be purely local, the result of an injury such as a nip or a blow, or even a slight wound in the immediate neighborhood of the synovial membrane. A very instructive case was shown by Mr. Shaw,[2] of a loose body, in the centre of which a piece of a needle was found. The

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[1] Klein: Virchow's Archiv, B. xxix. H. 1 and 2; Teale: Med. Chir. Trans., vol. xxxix.; Paget: St. Bartholomew's Hospital Reports, vol. vi.

[2] Pathol. Trans., vol. vi., p. 328.

needle at the time of its inception only passed partly through the synovial membrane, or did not pierce it at all, but remained in the subsynovial periarticular tissue; around the foreign body, with or without the previous formation of a blood-clot, hyperæmia and hyperplasia would occur, cartilage become formed, the protrusions into the joints would take place in the manner above described (p. 182).[1]

The element of traumatism, so frequent in the history of single loose bodies, has induced certain surgeons, forgetful how easily hyperplasia may result from such causes, to argue that most, if not all, false bodies in joints are but chips from a natural joint-surface. The opinion of one with so large an experience as Mr. Square of Plymouth, deserves the highest consideration; but he confesses this, his view, to be merely conjectural, and that he has never made any microscopic examination. Judging from the portraits of the bodies excised, which he has given,[2] it would be impossible to identify them with any portion of a normal joint. Mr. Teale, whose views Sir J. Paget, unacquainted with them at the time of writing, has endorsed, tends to teach that portions of articular cartilage being killed by injury, are afterward discharged into the joint by a process of "quiet necrosis." Klein's case does not, as Sir J. Paget supposes, support this view, but belongs to the class of direct and immediate chipping away of a piece of fresh unchanged normal cartilage.

I would also call attention to the fact that in other cavities besides the articular, false bodies form, for instance in the peritoneal and in the tunica vaginalis testis. In this latter, cartilaginous plates of considerable size have been found. In neither of these situations could there be any question of chipping from a normal part. Neither is the mode of protrusion and intrusion of a growth from without a cavity into its area confined to joints: tumors developed in the substance of the uterus will sometimes protrude into the cavity, form a stalk by elongation of the mucous membrane, become a pendulous, and occasionally an entirely loose polypus.

Symptoms.—Sometimes, he who has a movable body in so important a joint as the knee will be led to discover its presence by no sense of pain, barely of inconvenience, but either by accident or perhaps by some "queer feeling," which will cause him to examine the part with the hand. He then feels a lump, which probably will glide from his touch like a mouse—*Gelenkmaus*, as the Germans call it. The first sign, however, of so unwelcome a companion, is frequently a sudden severe pain of an indescribable character; the bones seem about to start from their places; the "joint is loosened;" but the limb is rigid, and the muscles fixed in spasm. The patient may fall violently, even though in a dangerous position, or, at the least, he will seek support on the nearest object until he can sit. The pain is described as sickening; it is frequently accompanied by vomiting, and under its influence strong men have fainted. There is at first great dread of any movement, though after a time comes the sense that, if the knee could only be straightened out or bent, all would be well. After a while, perhaps, a resolute effort, one way or the other, will release the joint; in other cases, it can only remain in the position in which it was seized. The patient is put to

[1] It is only just to Mr. Shaw to state that the mode of formation above described differs from his own. He supposes the needle to have been entirely forced into the articular cartilage, and to have produced an ecchondrosis; but this leaves out of the account the pedicle which he describes as a prolongation of the synovial membrane quite surrounding the body. This I hold could have only been produced in the manner I have stated.

[2] London Medical Review, vol. ii.

bed, and, in an uncertain number of hours, sometimes as many as seventy or eighty, the fixity relaxes.

This sort of attack is produced by intrusion of the false body between the bones (femur and tibia). In its more severe forms, it may be taken as certainly indicative of a loose body, though it should be noted that a milder form of attack is sometimes caused by subluxation of a meniscus, usually the internal. Such events are followed, at all events at their first occurrence, by pretty severe synovitis, while their frequent recurrence produces a great degree of dread and timidity of locomotion, and a more or less constant dwelling of the mind upon the matter. The joint, too, becomes stiffer and the limb weaker. Especially do patients dread its occurrence during sleep or half-sleep ; for with some persons turning in bed, or some half-unconscious movement of the limb, will even more easily than walking, entangle the body, and rouse the patient with a fit of severe suffering. These conditions will at last cause the sufferer to be most desirous of getting rid, even at some risk, of so troublesome a visitant.

The surgeon who is called to a case in which these symptoms have occurred for the first time may have considerable difficulty in finding any loose body, because, even though relieved from between the bones, it may have glided into some synovial fold or other nook ; also because there will very likely be such an amount of effusion as will help to conceal it. Indeed, if the joint be pretty full of fluid, he had better not even seek until it has become emptied. He may, indeed, have to visit his patient two or three times before he can find the offending cause. But, if the attacks have been pretty frequent, and the patient be aware that such a body is in the knee, he will have made it an object of some study ; will have learnt its manners and habits ; he will know where it usually resides, where it can best be felt, and by what movements he can bring it there ; also, when it slips from this spot, he will have learnt its lurking places, or how to entice it out of them ; so that, unless a very unobservant person, he can be of great aid to his attendant. The surgeon should at first hunt for the "mouse" with the lightest possible touch, lest he scare it away, and his hand must be acutely alive to any abnormal projection ; when such is found, it must not be directly pressed on, but surrounded at a little distance by as many fingers as may be wanted, which gradually approach each other till the body is closely imprisoned among them. A disengaged finger of each hand may then make the body course from one to the other, investigate its mobility, size, hardness, etc. When the surgeon has himself learnt something of its customs, he may go to work with less timidity. It may aid him to know that the more common places for finding these growths is on either femoral condyle ; chiefly, in my experience, the outer, just above the junction of the bones ; but I have come across them in front of the femur in some cases, just over the patella ; in others, considerably higher. I have also found them on the tibia, a little way inside the *ligamentum patellæ*.

When one of these substances has been found, the surgeon must look for others ; he will direct his patient to hold the one already caught, in place (sometimes a difficult matter with a body so fugitive, as aptly to suggest the term joint-mouse) ; and then, putting the limb into different postures, will search diligently and carefully for others ; but if the patient happen, by misadventure, to let his particular mouse escape, it must be captured again, and the search recommenced.

The growth or growths must then be examined in reference to their nature and conditions. A mere movable irregularity about a joint must not

at once be considered a false body within the cavity; if it be of an oval shape, and only glide a little way from side to side, and if it cannot be turned so that its long axis can be brought to be at a right angle to its former direction, the substance is probably not within the joint. Especially is scepticism valuable if the movable lump be a little above the outer condyle; for there is at this situation a fold or reduplication of the vastus externus and its fascia, which in fat knees and when the synovial membrane is rather distended, and sometimes when neither of these circumstances exist, slips inward and outward when pressed against the bone. The shape of this movable piece, the line of its mobility, and some other circumstances evident in the sequel, make the diagnosis sufficiently clear. None of these bodies are so attached as to enjoy only a backward and forward movement; they can all be made to travel in a circle, or at least a semicircle. Again, they are very seldom—at least those that give any trouble are very seldom—so closely attached but that they cannot be made to conceal themselves under some normal part, as the patella or its tendon, the tendon of the rectus, or one of the lateral ligaments. The intra-articular position of a movable something always found at the same place, and incapable of being thus concealed, is questionable.

If it have been clearly made out that the body is in the joint, its excursiveness will show if it be quite loose or be still attached; one in the latter condition will only travel a certain distance in a circle of certain radius around a particular spot; a body which is quite loose can, when the patient or a surgeon has learnt its idiosyncrasies, be moved and manipulated all over the cavity.

I do not think it possible to make out its formation, *i.e.*, whether osseous, cartilaginous, or a mixture of both; but the lipomatous loose body is soft, and as it glides away from the pressure of the finger imparts a peculiar half-doughy, half-resilient feel that reminds one of an oyster or slug held between finger and thumb.

The shape of such bodies is very easily made out, but, being covered by a considerable layer of soft tissue, they always impress one as being bigger than they really are.

Treatment.—Before deciding upon any line of treatment it is necessary to consider the number of bodies within the joint. Few surgeons—and I am of the number—would be bold enough, or in most cases I may say unwise enough, to extract a large number of such growths—chiefly for the reason that in such cases as may be gathered from the preceding section, the malady is a symptom merely of a grave disease, upon which the excision of such bodies could have no beneficial, but might be followed by injurious results.

The treatment of a loose body was originally excision by direct opening of the joint; it was an extremely dangerous proceeding, causing B. Bell to say that he would rather amputate the thigh in the upper third than undertake it; and we must remember that such operation was in those days pretty generally fatal. In consequence of the dangers of this proceeding, many methods of fixing the bodies, in some harmless part of the joint, have been devised, the most usual of which are retentive bandages of various shapes, adhesive, non-adhesive, elastic and non-elastic, combined or not with blisters to the surface, keeping the substance fixed to a spot by passing a needle through it from without; passing a wire suture through in the same way; also the *serre-fine* similarly employed, that is, kept *in situ* for a few days, until it is thought that adhesive inflammation has glued the body to the inner surface of the synovial membrane, or, what occurs quite

as frequently, until violent inflammation necessitates their removal. All these plans are usually delusive ; the bandages, well applied, diminish the danger of the body getting between the bones ; but, sooner or later, generally sooner, the accident recurs, to the great disappointment of the patient. Yet in the case of multiple bodies, one of which is troublesome, this treatment may be judiciously employed. The various little operations also may seem for a time successful ; but the body readily gets loose again. What else could we expect? Knowing that the movements to which it is subject have power enough to stretch and break its original pedicle, we surely ought to expect that the same forces would have greater power over new and comparatively weak adhesions, even if such be really formed. The only means whereby efficacious relief can be given is removal of the body by operation from the joint-cavity, and of these operations there are two : one by direct incision,[1] the other by subcutaneous opening of the capsule.

It is, I imagine, unnecessary here to describe at length the little contest between Mr. Syme and some who denied his claim ; it really does appear that both he and M. Goyrand hit simultaneously on the method of trying to avoid the dangers which attended direct excision of the cartilage, by performing the operation subcutaneously and in two steps or stages : 1. Dividing the capsule with a tenotome through a puncture of the skin. 2. After some days, when the wound of the synovial membrane may safely be considered healed, cutting through the skin and extracting the body from its new place. The surgeon, however, who has perfected this method and made it really feasible, which before his efforts it certainly was not, is Mr. Square, of Plymouth. He operates with a large-bladed tenotomy knife, and, before opening the capsule of the joint, he digs and cuts a passage and a burial-place in the peri-articular tissue for the body to pass along and lie in ; then he opens the synovial membrane rather freely, so that small size of opening, as compared with bulk of substance, may offer no hindrance to its passage ; and then the body is squeezed and coaxed out of the joint-cavity into the prepared hollow.

In spite of these and other efforts, the operation still remains a doubtful one : one that no surgeon, however skilful, can undertake feeling such certainty of completing it as when operating for stone, strangulated hernia, tying a vessel, etc. In certain special cases, all the circumstances being most favorable, success may pretty confidently be predicated ; yet even in such failure not unfrequently results. In other cases less advantageously circumstanced, failure becomes more likely than success. Failure means simply that, after opening the synovial membrane, the surgeon finds it impossible to make the body pass out of the cavity. This may either result from the pedicle remaining entire, or from the body slipping away and becoming lost or incapable of being brought back, or, having been thus several times recovered, gliding away again so often, that at last both patient and surgeon with great disgust acknowledge defeat.

The direct method, as that by valvular or oblique opening is now called, is thus carried out ; the body is carefully fixed, and an assistant shifts the skin over the deeper parts either upward or to one side, as may be most convenient. The surgeon then cuts straight down on the body, which either springs out at once or may be removed with any convenient instrument. This method is scarcely liable to failure, unless a somewhat clumsy assistant

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[1] By this term I do not mean cutting straight into the joint. Every surgeon at the present day would make the incision oblique or valvular—the term is used in contradistinction to the Syme-Goyrand method.

let the body escape his grasp, or unless the surgeon with insufficient courage make too small an opening.

The dangers which attend this operation are such as surround wounds into joints, viz., suppurative inflammation with all its injurious, nay, often fatal consequences; indeed, in certain hands, this has proved a highly dangerous, or rather deadly proceeding. Other surgeons, notably the late Carl Fock,[1] had very great success and immunity from ill consequences. I believe (but with our present surgical appliances the matter is of less moment) that success is most likely to be attained by making an opening sufficiently wide to avoid much kneading or squeezing of the joint, and by carefully closing, as the body passes out, the passage behind it so as to prevent any entrance of air into the joint-cavity. This closing must be done by the assistant as rapidly as possible behind the extruding body, nor must he relax the pressure of his hands until the wound is dressed and occluded. I now give statistics of the two different forms of operation and their results; for even now it is necessary to form a judgment as to the relative value of these procedures, and therefore to have a wide overlook on results which have been hitherto attained. Up to a certain point great facilities are offered me, for I am in a position to quote two sets of tables; the first that of M. Hippolyte Larrey, the second that of Dr. Benndorff.[2]

H. LARREY, 1860.

	Direct Excision.		Subcutaneous.	
	Number.	Per cent.	Number.	Per cent.
Success	98	74.8	19	48.7
Deaths	28	21.3	5	12.8
Failures	5	3.8	15	38.4
	131	99.9	39	99.9

BENNDORFF, 1867.

	Direct Excision.		Subcutaneous.	
	Number.	Per cent.	Number.	Per cent.
Rapid success	143	65.6	29	56.8
With severe complications	32	14.6	5	9.8
Deaths	41	18.8	5	9.9
Failures	2	0.9	12	23.5
	218	99.9	51	100.0

[1] Langenbeck's Archiv.

[2] Larrey gives his table in a discussion of the Parisian Société de Chirurgie. I quote from the Gazette des hôpitaux, 1861, p. 267. Benndorff's statistics are in a Thèse inaugurale, published at Leipzig in 1869. I have, in spite of many endeavors, been unable to obtain this work. I quote from Virchow's Jahresbericht. There is still an-

In looking at these tables, one cannot but be struck with the smaller percentage of failures for the subcutaneous method in Benndorff's statistics, and more especially by the fact that, while in 1861 Larrey found fifteen failures among thirty-nine cases, Benndorff found only twelve in 1867 among fifty-one cases. Larrey gives in every case the name of the operator, and I have been able for the larger number to verify his data, and thus I cannot but regard his table as the more reliable, since the divergence appears to arise, not from collection by Benndorff of a larger number of successes, but by omission of failures.

If we consider the results of the subcutaneous method, we cannot but be struck with the small percentage of success: in the one table less than half the cases operated on; in the other, nearly two-thirds only are cured; while about one-eighth in the former, one-tenth in the latter die. The enormous proportion of failures indicates the unreliable nature of the operation, and shows how difficult it is to estimate whether the body is in all respects so circumstanced as to render this mode of excision feasible. To this subject I must briefly revert.

In the method by direct excision, a different set of facts comes to our notice. Here we have of success 75 per cent. in the one table, 80 per cent. in the other; but we have also a rather high mortality and a considerable quantity of such grave complications as have endangered life, and either caused considerable or entire immobility of the joint.

I have taken considerable pains to collect all the cases since 1859 I could find recorded in hospital reports, journals, *Transactions*, etc., that are accessible to me. The cases are from almost every civilized country, and, with Larrey's table, will, I think, include nearly every published case since 1858.

BARWELL—EIGHTY-EIGHT CASES—1860-75.

	Direct.[1]		Subcutaneous.	
	Number.	Per cent.	Number.	Per cent.
Success	44	91.6	29	72.5
Deaths	4	8.4	1	2.5
Failures	..	....	10	25.0
	48	100.0	40	100.0

This table gives in its small figures a very different ratio of success for both forms of excision; but I cannot say that I regard the outcome as very indicative of the results of operation. It is not in man to publish his failures, even though unsuccess be not due to his own fault. And it is a little remarkable that I find recorded no single case of failure, unless it have been redeemed by a subsequent operation. This consideration will, of course, affect the subcutaneous rather than the direct method; a mere section of

other table which is mentioned in the Société de Chirurgie by M. de Chassaignac: it is ascribed by him to M. Berthenson of Odessa; but as it is somewhat singular in its results, I consider it hardly so reliable as to deserve quotation, and I find no mention of such writer in any publisher's list.

[1] Among the cases of direct excisions five were performed antiseptically.

the joint under the skin without result will be more likely to escape notice than an operation followed by death or other grave results.

Moreover, it is evident that modern surgery has introduced greater attention to cleanliness, greater care in exclusion of air, and other means, which render opening a synovial membrane a far less dangerous proceeding than formerly; while it may well be doubted whether, since Mr. Square began his improvements, anything remains to be done for the perfection of the subcutaneous mode; but that surgeon had four failures in fourteen operations.

I have excised a large number of loose cartilages, and have never experienced either a failure or an untoward event. One patient operated on before I had come to place faith in antisepticism, experienced some time after the wound was closed a smart attack of synovitis—either not at all or only indirectly connected with the operation. Those operated on antiseptically had no synovitis, nor indeed any adverse symptom.

In such operation, antiseptic precautions must be rigidly enforced. The opening should be free enough to allow the body to jump out at once. If it do not do so, its position must be carefully ascertained from without, and either the finger or a vulsellum passed into the wound, the body seized and carefully extracted, the greatest care being taken not to take up, pinch, or in any way roughly use the synovial membrane. All these directions are easily followed, but not so the rule to cut down on the body. To make an incision of considerable depth down upon a body so movable as a joint-mouse, without driving it out of position, is impossible. I have therefore, in my later operations, selected a place where the body either habitually lies or passes to, from the immediate vicinity with great ease; I take care that the substance lies close to it, and cut into the joint there, where, viz., the body is not; and then from its situation close by, where it has lain undisturbed, the slightest pressure will cause it to extrude, if it be not bound down by a pedicle, the treatment of which will be evident from the cases recorded.

Case LI.—J. M., a sailor, aged forty-two, sustained a fracture of the humerus through the condyles in February, 1858. The bone united well, and in four months he went to sea again with good and but very slightly restricted movement of the elbow-joint. He returned to me at Charing Cross Hospital to show me the limb. The elbow-joint was rather weak, and contained a large quantity of fluid, together with a number of loose bodies. I counted eleven such in the joint itself. There was besides a pouch-like elongation of the synovial membrane upward above the inner condyle: this was the size of a bantam's egg, contained a considerable amount of fluid, and a number which could not be counted, but which I should estimate at from 30 to 40, of easily movable bodies; the sac felt like a bag of marbles. I tried to detain this man, but after the manner of sailors he disappeared. Except that his arm was a little weak, he felt no inconvenience from the condition of the elbow.

The next case, referred to in the text as suffering a subsequent synovitis, is remarkable in its history, which appears scarcely compatible with the symptoms. The genesis of the little bony lump is quite obscure.

Case LII.—C. H., aged forty-three, came into my room on July 21, 1875, and reminded me of his having consulted me in 1872 on account of pain and difficulty on moving his right knee. He further reminded me that I,

finding him in a very rheumatic condition, had counselled a residence abroad, and that I had mentioned the proclivity of his then condition toward forming one or more false bodies in the affected knee. I remembered, as he mentioned it, having been impressed by the peculiar rough condition and the grating of his synovial membrane.

He gave the following history of his condition at the above date. In the last week of May he tried to get into a carriage of the Metropolitan Railway whilst it was in motion. He struck his knee sharply, and was thrown back, with some violence, upon the platform: got up quickly, and out of the way, fearing to be taken in charge. The next day he found a loose body in the knee; he had no synovitis or pain. He also said that, after this accident, he missed a lump which he previously had over the inner condyle.

I found the body easily at the time, and on several subsequent occasions; it had no fixed residence but, by certain movements of the limb, the patient could bring it into view. It appeared somewhat rough, hard, and about the size of a horse-bean. It could be moved into almost any part of the knee, but most easily into the subcrureal sac. As a merely temporary expedient, I fastened it in that situation with pad and strapping. It remained stationary after this for a day or two, then slipped away, and caused a good deal of pain. Though he had never had a violent seizure, the annoyance was so considerable, and being a nervous person, the dread of such an attack was so troublesome, that he greatly desired removal of the body.

FIG. 20.—Loose body. Natural size.

July 10th.—I got the body into place where it could be best fixed—viz., above the outer condyle—and operated after Square's method, but the body would not pass out; it slipped away, and could not be found.

July 17th.—No bad symptoms had resulted, and, prior to opening the membrane, I made an attempt to fix the body with a Glover's needle in a properly constructed needle-holder. I found it so hard, that it was impossible to introduce the point. I declined to attempt subcutaneous removal, fearing another failure under these conditions.

July 31st.—He was determined to have the body removed; and I operated at the place where the body could best be fixed, viz., above the outer condyle, with considerable shifting of the skin, and perfect exclusion of air, with instruments well cleaned with carbolic acid. The body would not come of itself from the joint, and I had some difficulty, owing to its roundness and hardness, in getting any forceps to hold it; but, after a little, I succeeded in extracting it, the edges of the wound being held close behind the body, so as to obviate any entrance of air. It was stitched, painted with collodion, and, when this was dry, covered with cotton-wool; the limb was then placed on an Amesbury splint. Barely any swelling took place; the part remained free from pain, though slight tenderness round the wound could, as might be expected, be discovered. In fact, I regarded the patient as convalescent, when, on the morning of August 8th, I was sent for in great haste. I found that he had, feeling some slight pain the day before, discarded the warm applications that I, knowing his rheumatic tendency, had prescribed, and used a spray of cold—I believe ice-cold—water. A complication arose, which had nothing to do with the operation. The knee swelled; the swelling did not fluctuate; it was rather hard, and not rounded like acute synovitis. The pain seemed to be severe; but the temperature never reached 100°, nor were there other signs of pyrexia. The attack was, I believe, rheumatic, a condition to which he was very subject, combined

with neuralgia. Convalescence was rather tardy. In the middle of September he went down-stairs, and shortly afterward was out of doors. In the middle of October he went to Scotland, where he soon recovered the full use of the limb.

The body seemed nearly as hard as the enamel of teeth; it had adhering to it some shreds of membrane, which probably were the remains of the pedicle. No broken bony or calcareous part indicated that a hard stalk had been snapped off by the accident above described. This body is now in the Museum of the College of Surgeons. Pathol. Series, No. 957C.

Again, in my second case, we have history of injury; and again the body shows every appearance of being no normal part of the joint, but a growth in the immediate subsynovial tissue; the first impulse to which was doubtless given by a blow, setting up first inflammatory, and then formative, action, as described in my first Lecture. The body was, I am sorry to say, lost in the theatre, while I was performing another operation, by some inadvertence of one to whom it was entrusted. I had carefully examined it; it was an oval plano-concave plate of cartilage: the concave side was toward the joint cavity, the plain side directed toward the superficies. In dimensions, its long axis was nearly an inch, its short axis rather over half an inch; the thickest part, namely the edge, was as thick as a not very new shilling. One of the long sides of the oval had on it a shallow gap or bay, so that the whole outline was somewhat kidney- or ear-shaped. The cartilage composing this substance had the bluish tinge of the hyaline variety of structure; about the centre, its thinnest portion, two or three roughened and whitened spots showed that plates of calciform matter had been deposited. All one surface, and a portion of the other, had attached to it a fine vascular membrane; I have no doubt this was a protruded mesentery or stalk, if I may so call it, formed from synovial tissue; neither have I any doubt that this body was one of those formed in the tissue immediately underlying that structure.

Case LIII.—T. de G., aged twenty-six, tailor, was admitted under my care into the Charing Cross Hospital on October 15, 1875, saying that he had a loose body in his knee (left). When thirteen years of age, a large stone fell on his knee; he suffered no pain or trouble at the time. He first discovered some loose substance in the knee six years ago; it was then, he said, situated over the inner condyle of the femur, and was but slightly movable. For two years it remained in this place, and he thought nothing of it. In 1871, after a long walk, it suddenly slipped between the bones; he fell down with the pain, and was very sick and faint. Afterward the knee swelled, and he had to lay up. The same thing recurred several times, though not for some months, yet he so dreaded the accident, that he was determined to have the substance removed. The body's favorite resting-place was at the outer condyle, but it had considerable range, though apparently not quite free movement; it felt flat, about the size of a sixpence.[1]

November 3d.—Under chloroform and carbolic acid spray, and with the skin a good deal pulled inward, I made a semilunar incision over the body, and deepened it till I felt the synovial membrane loose below my finger. I waited a few seconds to see that the bleeding was quite trifling, and then

[1] I believe his story as to the place where the body first appeared to be extremely doubtful.

opened the joint. The body did not come to the surface, as is usual with free ones, nor did I see it at the bottom of the wound. I passed my finger very gently in, and felt that it had slipped a little, so that its inner edge only lay under the outer lip of the wound. I introduced a very narrow-bladed forceps, and lifted the body into the wound. It was attached by a rather broad pedicle, and this had to be divided before the substance could be removed. The lips of the wound were stitched with carbolized gut, dried rapidly, and thickly covered with collodion; the limb placed on a MacIntyre splint, with a thick pad of cotton-wool over the joint, and the whole put on a swing-cradle. No synovia flowed during the operation, and I believe no air entered the wound.

FIG. 21.—Loose body. Natural size.

During the first week he had occasional attacks of pain in the knee; these were paroxysmal, and of the sort which occur in the malady which I have termed dry or fibrinous synovitis. A blister was applied above the joint, across the front of the thigh; this relieved the pain; the temperature was never more than 99.2°.

November 17th.—He was allowed to get up. The limb was a little stiff from confinement.

November 23d.—He went out walking well, with barely any stiffness. In ten days this stiffness had quite worn off.

The next case is one of interest in many ways. Firstly, lipomatous growths are by no means uncommon, either in the peritoneum or in the tunica vaginalis; and at these places they appear as pedunculated or as loose bodies; but so large a fatty growth, arising from a synovial membrane, is very rare. Secondly, the surgical value of the case is very considerable. Hydarthrosis frequently is incurable, either by iodine injections or other means; and the knee of A. D. would probably have belonged to this class of irremediable disease if the bodies had not been excised. Whether most cases of very obstinate hydarthrosis—those that resist every treatment—are dependent on the presence of undiscovered, perhaps undiscoverable growths or membranous adhesions, is a subject for future consideration; as yet, data are not forthcoming for the solution of this question. A. D. has suffered no pain, no weakness, no swelling of the left knee, since she recovered from the operation; but a strongly marked condition, constitutional or local, is present, which so disposes those joints to hydarthrosis that the other knee appears to be taking on similar action.

CASE LIV.—Alice D., aged twenty-six, was admitted under my care into Charing Cross Hospital, on October 16th, with hydarthrosis of left knee. She is a tall, stout, healthy young woman, but hysterical. In examining the joint, I found, just above the patella, a movable body, which seemed soft and rather large; and, on further examination, detected over the outer condyle another such growth. These bodies enjoyed but a small range of motion. The knee was large, and contained a considerable quantity of fluid; but it should be noted that both knees were fat and big; the following are the dimensions:

	Right.	Left.
Over patella	$14\frac{1}{4}$ inches.	$17\frac{3}{4}$ inches.
Across "	14 "	$15\frac{3}{4}$ "
Beneath "	13 "	$14\frac{1}{2}$ "

In consequence of great press of patients for admission, I was obliged to send her out until another vacancy could be procured. The rest had been of some benefit; on her leaving, the dimensions of the left knee were: over patella, 17¼ inches; across, 15½ inches; beneath, 14½ inches.

November 2d.—A. D. was readmitted. She had been suffering a good deal of pain in the knee, especially when walking, which she did with difficulty. The size was again increased: above patella, 17¾ inches; across, 15¾ inches; beneath, 14½ inches.

It will be observed that the chief swelling, as in all cases of hydarthrosis, is above the patella, and this is the site of the loose bodies. I examined the bodies very carefully; they appeared oval, and about the size of ordinary spectacle-glasses, and about as thick through as their short diameter, the inner one being rather the larger; they were rather soft, and enjoyed no large range of motion; the inner one, which lay in front of the femur, with its lower edge about half an inch above the patella, could be pushed to the inner condyle, but not to the outer; it could be pressed under the patella, also, about an inch and a half higher than its usual seat. The outer one had a more limited range; it could be made to describe a semicircle round the outer side of the outer condyle, its end protruding a little way under the patella.

Previous to the discovery of these bodies, I had intended to treat the hydarthrosis by injection, but now this appeared to me futile while they remained in the joint; and, with the consent of my colleagues, I determined to excise them.

November 20th.—She had been kept in bed since her admission for twelve days, with her leg on a pillow; the swelling of the knee had somewhat decreased. A week ago, I had the limb placed on a MacIntyre splint, and fixed the above date for operation. Yesterday, the knee being measured, gave the following dimensions: above patella, 17 inches; across, 15¼ inches; below, 14 inches.

I operated, the patient being under chloroform, with the antiseptic precautions, by making a slightly curved longitudinal incision above and on the inner margin of the external condyle; this I gradually deepened, and, waiting till the slight hemorrhage had nearly ceased, I opened the synovial membrane. After a little manœuvring, the outer body sprang out, and hung by a small stalk; this was cut through. I found it impossible to get the inner body to protrude. I therefore wiped all blood from my finger; and, after subjecting it for a while to the spray, introduced it carefully into the joint, easily found the body, but could not draw it further inward. I followed it with my finger across the joint to the inner condyle, and tried to detach it, but was foiled. I now seized it in a pair of forceps, drew it as far as possible out of the wound, and, with a scalpel introduced as far as was safe, separated it, leaving a very small part of the body behind, in the hope that it would shrivel away. A good deal of synovia flowed during the operation. The bodies were lipomatous, and, while warm, looked, except that they were more pear-shaped, exactly like native oysters without

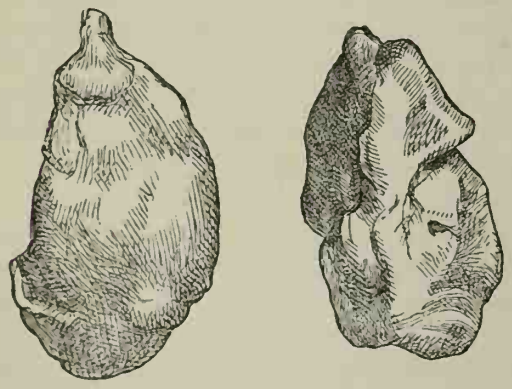

FIG. 22.—Representations (natural size) of the bodies removed. The one on the right is that which grew from the inner condyle; the left, that which grew from the outer.

the beard ; the color and size were exact imitations while they were warm, but, on getting cold, the translucent parts changed in appearance, and then became still more white and opaque on being put into spirit.

December 2d.—She had had occasional attacks of pain, but not severe. The temperature varied from 98.4° to 100° ; pulse quite normal. I undid the bandages, removed the cotton-wool and the collodion covering, which was rather loose. The wound had not healed. Between its lips was a clot of blood, looking as purple and as fresh as though it had only just been effused. The knee appeared a good deal smaller than it was before operation ; she had some slight tenderness over the whole joint, but chiefly at a place over the inner condyle, which she, unprompted, described as "the place where you removed the larger body."

December 13th.—The wound was healed. There was hardly any tenderness, probably no real tenderness ; but it was difficult to judge. She had rather frequent and prolonged fits of hysterical weeping. I removed the splint, and moved the leg through about 30° quite smoothly and without pain.

December 23d.—She went out walking, well and free from pain. The size of the knee was : above patella, 15 inches ; across, 14½ inches ; below, 13½ inches.

March 8th.—The patient not having presented herself for examination as ordered, I found her at her residence. The knee was perfectly well, having the same dimensions as above. The part of the inner loose body which I had been obliged to leave attached could not be detected. The other knee showed some swelling and tendency to hydarthrosis. She stated that she never had any pain nor sense of weakness in the left, the operated knee, but occasional pain in the other.

In considering the result of these cases and the choice of operation, it is to be observed that the subcutaneous method must have failed in the two last, the bodies being, all three of them, attached to the synovial membrane of the joint. The fact of their having marked limits to their mobility—much wider in the case of de G. than in that of Alice D.—had apprised me of this condition. In the first case, although the body was evidently perfectly free, and although I made a quite sufficiently wide opening in the capsule of the joint, it was impossible to extrude the substance : this I attribute to its hardness and to its rounded shape. These observations bear out the remarks that the subcutaneous method must in certain cases fail, and that such mode of operation should be avoided when limited mobility indicates persistence of the peduncle ; further, that such method will occasionally fail, even when larger mobility exists, and gives assurance of an entirely free substance.

I have commenced this section on the treatment of loose bodies with a description of operative procedures, because they are the only means by which a cure can be assured ; but mention must also be made of certain other methods, which, though less reliable, are nevertheless valuable. These all resolve themselves into devices for retaining the body for a certain time in some definite spot of the joint-sac. I should unhesitatingly reject all the plans which necessitate transfixing a fold of the synovial membrane, whether with a hair-lip pin, a silver wire, or a *serre-fine*, they being less efficacious and quite as dangerous as excision properly performed. Thus the permissible methods can only consist of some well-devised means of exerting pressure from without, not upon but around the false body, previously manipulated into a convenient position.

Several folds of lint, into which a hole of commensurable size has been cut, may be so placed and fixed with strapping-plaster, that the body lies in the opening, while firm pressure all around it tends to prevent its escape. Lint, however, is, as a rule, too soft a substance for this purpose. Better materials are either the sort of sole-leather used for splints, or some soft metal, either lead or pewter, in sheet, about a quarter of an inch thick. If the former be preferred, it should be cut of proper size, a circle or oval, about 2½ inches in diameter; in it a hole should be made, which is to receive the slightly projecting body. The leather is then to be steeped in hot water, with a little vinegar, and to be firmly bandaged on the limb. The same mode of arrangement, except the steeping, is suitable for a pad made of soft metal, but a piece of thin mackintosh, especially if lead be used, is to be introduced between the metal and the skin, lest deleterious absorption take place. When the leather has become dry, strapping-plaster may be substituted for the bandage; it may be used at once as the best means of securing a metal pad.

These devices are valuable as palliative treatment, or as means of impounding a body which perhaps has been found with difficulty, until the next visit, or until preparations for operation are completed.[1]

If there be in the joint a multitude of false bodies, some of which are troublesome, alleviation may be effected by kneading and manipulating them into some favorable position—as, for instance, for the knee, the subcrureal pouch, or for the elbow, the dilatation near the inner condyle, causing them to be carefully held in place by an assistant, emptying the joint by aspiration, passing a perforated metal pad over the whole collection, and tightly enveloping the limb in plaster-of-Paris. When the bandage is removed, several bodies are generally found pretty closely attached, and the movement of others is very much restricted.

I described at p. 184. the sudden painful attack which often gives the first intimation that a false body is in the knee. It must, however, be said that a similar seizure may follow displacement of a meniscus. On the first occasion, if the patient seek advice while the joint is still painful and stiff, the surgeon may detect abnormal prominence of an inter-articular cartilage, or may not be able to define which condition produces the symptoms; nor is the immediate diagnosis important, since the first treatment in either contingency is alike, namely, to restore mobility. This is done (an anæsthetic may be necessary) by bending the patient's knee to the full extent. The joint should then again be examined. It may be that a false body will be found; if not, the following hints may aid diagnosis. Subluxation of a menisc causes less pain than a joint-mouse; the knee is fixed in a straighter posture; there is distinct tenderness at the spot, often a prominence, which on flexion disappears. Subsequent synovitis is not so common, and when it occurs is less acute. The synovial membrane is smooth. After replacement, a bandage should be firmly applied, and, for a few weeks afterward, an elastic bandage or knee-cap should be worn.

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[1] On one occasion I thus fixed a rather small but very troublesome false body, and three days afterward found that it was hardly mobile. I repeated the application, and found the adhesions become firmer; my patient was cured. A tolerably long acquaintance justifies the assertion.

ON DISEASES COMMENCING IN THE BONES.

CHAPTER X.

ACUTE ARTICULAR OSTITIS.

The diseases of the joints hitherto examined have all taken their rise in the soft parts, that is, in the synovial membrane and subsynovial tissue. Another class of these maladies begin in the bone; like those already described, these all originate in inflammation;[1] and ostitis is a disease that has been known from time immemorial. In the next few chapters, as I wish to designate those osseous inflammations which, situated close to a joint, affect the integrity of its mechanism, I shall term the diseases articular ostitis of different kinds, meaning by that term inflammation of a joint-bone.

Some writers would wish to confound together all articular affections, whether arising in one structure or another, under the name "joint disease," chiefly, as it appears to me, because it is barely possible at the end of a destructive malady to decide on the place of its commencement. The two articular constituents prone to disease are, however, as different in their physiology and pathology as are any two neighboring structures of the same body. Is he wrong who would divide pleurisy from pneumonia, and both from bronchitis, who would separate meningitis from cerebritis, conjunctivitis from sclerotitis? If not, why is the attempt to distinguish between two different forms of articular disease to be called "to separate natural wholes into artificial parts, to dissect disease?"[2] It appears to me, that the separation of different forms of disease, occurring in complex parts, is that point in modern surgery upon which our progress chiefly depends. I certainly should not have dreamed that the distinction between a bone and a synovial membrane could ever be considered "artificial."

No one who has seen a case or two, for instance, of acute ostitis, but must be impressed with the fact that early recognition of the malady gives over it a power that is inevitably lost if the surgeon, considering it "joint disease" and nothing else, wait till the worst is fully developed. In chronic maladies, owning the same origin, the like fact, if less striking, is nevertheless not less true.

In certain cases even, if our accurate knowledge of the malady, of what it is doing, and to what it will lead, may not greatly add to our power of treatment, it will give us at least that of prognosis. We can tell our patient

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[1] Malignant disease and tumors, either of soft parts or of bone, do not come under our consideration.

[2] Surgical Treatment of Children's Diseases, T. Holmes, p. 411.

or his friends what state the disease will leave him in; we can give him a definite assurance of the future, which must be denied to the believer of "joint disease as a whole."

I, therefore, do not doubt that, as our knowledge of the processes of diseases in the joints advances and approaches nearer to the precision of our acquaintance with those in the eye, so will the distinctions between the one form of malady and the other be more minutely drawn, and more universally used and acknowledged; that remedies more especially adapted to the individuality of the disease may be forthcoming, so that some which are now treated as "joint disease" will in the future be managed in a more discriminating manner. Even now, a very few years after the work above quoted has endeavored to discourage all attempts at differential diagnosis, Mr. Smith's cases,[1] and Mr. Brown's case,[2] show that the surgical mind has advanced beyond such teaching.

In carefully weighing the methods whereby I may most readily and surely convey a clear comprehension of the different clinical and pathological facts, with which experience and study have made me familiar, it has seemed to me impossible to include the whole series under the two classical headings of acute and chronic, since either one or the other of these would of necessity embrace a wider range of actions than can fairly be described under such headings. We have, namely, a certain form of bone inflammation, which terminates very quickly in widespread gangrene, or, as it is here termed, necrosis. Another, in which abscess forms within the bone, or in the cartilage about to become bone, with more or less rapidity, being accompanied by slight, only partial, and not very rapid necrosis. A third, in which the osseous tissue becomes in part sclerosed, in part softened and fatty; pus forming slowly, if at all, its production not being a prominent portion of the morbid act, while necrosis is generally altogether absent, or may be molecular, or of a carious character. These considerations have led me to divide such ostitis, as we have to do with in a treatise on joint disease, into three sections, which may, I think, most judiciously be termed peracute, acute, and chronic. I prefer these designations to acute, subacute, and chronic, because the middle term of the three, that which tends with considerable rapidity to abscess in a joint-end, is often of too rapid a nature to come fairly under the class subacute.

Peracute Articular Ostitis.—If chronic affections of bone-tissue are the slowest of all maladies with which the surgeon has to do, so are acute diseases of those parts among the most rapid and most formidable, not merely on account of their local, but also of their general effect. Nevertheless, even in those forms of inflammation which fully deserve the title of acute, there are sundry degrees of violence, and certain differences of form, which render some classes of the disease much more severe and more constantly fatal than others. It is to be understood, from the beginning, that the whole bone-tissue, with its membranes, both lining and investing, are in these cases involved, hence the term osteo-myelitis. In some the action is circumscribed (*osteo-myelitis, circumscripta*); in others, diffused (*diffusa*); and this form frequently partakes of the nature of phlegmon or erysipelas, with phlebitis of soft parts; hence the term *osteo-phlebitis diffusa.* On the different degrees of gravity of maladies so named I need scarcely here insist.

Peracute ostitis is almost confined to young life, and to the ends of

[1] Bartholomew's Hospital Reports, vol. x., p. 190.
[2] Clinical Society Transactions, vol. ix., p. 175.

long bones. At all events, this is the one form of disease which interests us here. It involves either, first, the epiphysis, and spreading, thence by way of the periosteum to the next adjacent part of the shaft, or more frequently begins quite at the lower end of the shaft, and passes on to the epiphysis. In such position the inflammation is generally diffuse, though not of necessity phlebitic. Another form, less violent, commences on one or the other side of the epiphysal line, is generally circumscribed, or but partially diffuse; it is less grave in character and symptoms, unless the resultant pus pass into the neighboring joint.

I propose to commence with the former class of disease. It has been ascribed to some violence, even though slight, to severe chill, or over-exertion, and again by others has been considered as the local expression of a systemic cachexia. The same divergence of view concerning the origin of erysipelas and erysipeloid inflammations of soft parts, diffuse phlegmon and phlebitis exists. To my mind it appears impossible that any one part of the body can be affected by a violent non-mechanical disease, that shall be entirely local. It is important to bear in mind that occasionally the malady is multiple, that is to say, a number of bones are involved in such rapid succession, that they seem simultaneously attacked. No ordinary local injury could in a healthy state of system set up such perbulent action, for every healthy child running and romping about the world receives unharmed a number of knocks and bruises far more severe than those to which this disease has often been ascribed. Yet it must be remembered that local pain, heat and tenderness do as a rule precede, if only by a short time, systemic manifestations. Hence there is good ground for believing that certain local disturbances, which, under favorable conditions, would remain within moderate bounds, can surge into violent and destructive disease if they happen to coincide with a moment when the constitution is worn by over-fatigue, want of good or sufficient food, and fresh air, or is depressed by severe chill, perhaps even by malarious influence.

Such conditions act with greater power upon the immature constitution of the young; and it is at that period of life that the bones are in a state of great formative excitement, accompanied at their extremities by a hyperæmia and tension, that very easily oversteps the narrow limit which separates it on the one hand from inflammation, on the other from congestion and venous stasis. Moreover, we cannot but be struck by this peculiarity, that the bone-ends, most liable to this form of disease, are precisely those whose increase has the most marked influence on the growth of the body, and at those ends of them where that activity chiefly prevails. Thus the malady is most frequent—1st, at the lower end of the femur; 2d, at the upper end of the tibia; 3d, upper end of ulna, lower end of humerus, and lower end of tibia equally; 4th, upper end of femur; 5th, upper end of humerus.

The disease commences with increased hyperæmia of a part which, in earlier life, is already hyperæmic, accompanied by blood extravasations of smaller or greater extent, and by effusion of more or less deeply blood-stained serum into the medullary hollow or cancellous cavities as the case may be.[1] These phenomena are closely followed by free proliferation of

[1] The minute anatomy of ostitis has been deferred to another chapter, since the conditions of the peracute form, though similar, are too hurried to form good material for investigation; moreover, they are stopped at a certain point by death of the affected part. The reader therefore is referred to Chapter XI. for a full elucidation of this subject. In the very acute disease, the processes of absorption of lime-salts, formation of Howship's lacunæ are by the venous stasis and suppurative energy

the medullary membrane, producing here pus, there soft granulation-tissue, which latter in the severe and diffuse cases is quite unstable, and soon melts away into puriform fluid; but in the circumscribed cases persists in places, and forms boundaries to the localized abscess or abscesses. It is precisely on the persistent or transient nature of these limiting granulations that the diffuse or circumscribed nature of the case depends. If they are persistent, and tend to the formation of new tissue, the malady will end in a localized abscess or abscesses, with, in all probability, some partial necrosis surrounded by sclerosis. If, on the contrary, proliferation of the medullary membrane produce chiefly pus and transient granulations, soon dissolving into a puriform fluid, no limiting tissue can be formed—the suppuration is diffuse. After a short interval, the hitherto semi-solid medulla dissolves into oil-drops, which mingle freely with the inflammatory fluids. At this period it is not usual to find the interior of the bone filled with diffused pus, although, in the worst form of disease, that described by Chassaignac and Klose, such appearance may occur. The medullary canal, or the spongy end, presents, when the bone is split lengthwise, a mottled aspect, part being of a reddish purple (highly vascular granulation-tissue), part yellow or orange (pus and blood); in some cases the former, in others the latter hue will predominate. In others again, pus collections connected by narrow channels, a chaplet of little abscesses permeate the inflamed portion of the bone. Whatever the color of the contents, they always, on section, bulge and protrude out of the cavity, and pour forth inflammatory fluids mixed with oil-globules.

For the mere fact of an unyielding bone case being hyperæmic, *i.e.*, containing an abnormal quantity of blood, connotes that there must be an abnormal amount of pressure, and when to this we add rapid formation of new products, it is evident that pressure must be very considerable. Hence arise venous stasis, or thrombosis, within the cavity, and the singular transpiration of oil-drops from the medulla through the bone. It is, I believe, upon the intensity of this intra-osseous pressure that the greater or less destruction of tissue, the more or less virulence of the disease, depends; and the commencement of the second phase, namely, participation of parts lying without the bone, corresponds in a definite ratio with the stasis resulting from the species of strangulation within it. The extrinsic phenomena are suppurative periostitis, with phlegmon of the limb generally; the former is co-extensive with the myelitis, the latter reaches a little higher.

Suppuration of the periosteum leads very rapidly to abscess both inside and outside that membrane; but in neither situation is all the fluid formed *in loco*, for it, more especially that beneath the periosteum, is mingled with large oil-globules, evidently emanating from the interior of the bone. This fluid is frequently blood-stained, or, when not thus colored, is greenish, or may be brown by admixture with the results of bone-decomposition. It has, more especially when of the latter hue, an evil, sometimes a very offensive odor. In the soft parts of the limb, along the course of the vessels, and in the intermuscular spaces, large effusion of serum takes place; near the focus of disease this will be intermixed with pus, but further away is free of such admixture; in all but the milder form of case it is markedly blood-stained. In the more severe, more pyæmic form of the disease, thrombosis of the veins occurs, reaching sometimes from the

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merged into simple somatic death of the bone, or, in those parts where this does not take place, by gradual re-establishment of the circulation followed by thickening and induration (osteo-sclerosis).

smallest radicles to the largest and highest trunks. The clots are frequently decomposed, and breaking down into ichor-like pus.

It will be gathered from the above that peracute epiphysal ostitis has not only many different degrees of acuity, but that the inflammation itself may be of different characters.

There is no doubt that the description given by Chassaignac[1] and by Klose[2] is highly colored, because those authors only had in view the worst and most diffuse cases, such as are comparable to erysipelas or phlebitis of soft parts, such indeed as are also called osteo-phlebitis, and are closely related to pyæmia. Such disease appears to be occasionally epidemic, or endemic in certain parts of the world; but fortunately seldom occurs in England; therefore I would merely indicate its morbid anatomy as the extreme of what has been described above. Purple hyperæmia, large blotches of extravasation and dark-colored pus, occupy the interior of the bone, while outside it are found separation of the highly-congested periosteum, which contains, besides, the dead or dying, greenish or blackened bone, blood-clots, dark-colored offensive pus, and quantities of oil-globules; the veins of the bone, of the periosteum and of the surrounding soft parts, are filled with decomposing coagula, and lie in tissues bathed in ichor and blood-stained flocculent pus.

Even such violent disease as this, however, does not necessarily prove rapidly fatal; but under favorable circumstances the most acute and violent symptoms may pass, at or about the end of the second week, into a less virulent phase, and may then either end fatally by exhaustion, or give rise to amputation in the third or fourth week; or, on the contrary, may, under judicious management, get well by slow degrees. In either case it may happen that the epiphysis will separate more or less completely, though this is not so necessary a sequence as some authors believe; but disease of a neighboring joint always occurs somewhere between the tenth and twenty-fourth day.

The former of these conditions, though not invariable, is a sufficiently frequent occurrence to cause Klose to term the disease "Epiphysentrennung." Its occurrence depends, in a great degree, upon the stress of the inflammation falling on the parts immediately next the epiphysal line. Sometimes the separation takes place in an incomplete form, a deep groove being channelled between shaft and epiphysis—a certain bend or twist occurring at this junction, but no absolute disruption. Occasionally, this disease is multiple, more particularly when it attacks primarily an epiphysal junction; but multiple suppurative osteo-myelitis may occur, whatever be the anatomical seat of primary attack. Such cases have been seen by several observers, but the most remarkable instance is one related by Dr. Demme, of Berne, in which almost every larger epiphysis was separated by suppuration at the line of junction (Demme, Wiener Medicin-Halle, 1864). The disease, in such instances, commences in one bone, the affection of the others is secondary and probably pyæmic; but the relationship which causes pyæmic conditions to pass from one epiphysis to another, previous to affecting internal organs, is quite occult.

It may be affirmed, with the nearest possible approach to certainty, that acute suppurative ostitis of any bone-end never occurs without inducing some affection of joints. Chassaignac was the first to point out this

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[1] Gazette médicale, 1854, Nos. 33, 35, 36, 37.

[2] Prager Vierteljahrschrift, 1858, to which I more especially referred in my first edition.

fact, but he erred in supposing that the proximal joint, that between the disease and the heart, was always the one attacked ; the fact being that the knee, even if the primary disease lie above the middle of the femur, or below the middle of the tibia, is more often involved than either the hip or ankle. At the upper arm the joint nearest the focus of inflammation is the one to be diseased. While if the radius and ulna be the seat of inflammation, anywhere above their lower ends, the elbow will be then most commonly invaded.

In studying the nature of the joint-affections, which are associated with peracute ostitis, we must take care to distinguish those that are primary and simultaneous from those that are secondary and subsequent. We must distinctly recognize the independence of such rheumatic, traumatic, or other inflammations as have been produced by the very same violence or exposure which caused the bone disease—inflammations which arise not merely at the same time, but may even precede the other malady. These conditions were entirely overlooked by the earlier observers (Chassaignac, Klose, Paul J. Roux), who also very much exaggerated the supposed constant gravity of the secondary, the dependent joint affections—they are often comparatively slight, and may, if the bone disease terminate favorably, get quite well. Of secondary affections there are several sorts : (1) Serous synovitis, produced by extension of inflammation from the periosteum ; (2) mere passive serous effusion (not a true hydarthrosis) from pressure on and thrombosis of veins leading directly from the joint ; (3) muco-purulent effusion into the synovial membrane ; (4) pyæmic ; and (5) suppurative synovitis.

The first three of these scarcely need further comment, their morbid anatomy having been already described. I would, however, refer the reader to the chapter on Hydarthrosis for a full description of its frequent ostitic origin, especially that form which is rich in moss-like growths ; to Chapter II. for the frequency with which the simple effusion may gradually become purulent, etc.—all these may get well either entirely or with a small amount of stiffness.

The next two processes can hardly persist without destruction of the joint ; anchylosis, more or less complete, being probably the most favorable issue possible. Pyæmic conditions are not so common at the joint next to the focus of disease as they are in those secondarily affected when the multiple form of the malady obtains. Suppurative synovitis is produced by the passage, into the joint-cavity, of pus and inflammatory products, as well as by spread of the disease from the focus of inflammation. The irruption of pus into the synovial membrane is not to be regarded in the same light as though it took place with great suddenness, as a thunderbolt from a clear sky, into a healthy membrane. On the contrary, the inflammation spreads gradually through the periosteum and cartilage : this latter will after a time be perforated, rather might I say punctured, in one or more small holes, out of which, at first a little, then more pus distils into a cavity lined not so much by highly sensitive synovial membrane as by inflammation-tissue, granulating and inured to the contact of puruloid fluid ; or, perhaps, the cartilage is simply shed, detaches itself slowly at one or the other spot, with the like result. When separation, partial or total, of the epiphysis takes place, the joint may be nearly healthy ; whether this occurrence will much affect its condition depends upon the position, inside or outside the capsule, of the epiphysal line. Diastasis in itself does not affect in any way, save that of position, a joint whose synovial membrane is altogether free of the epiphysal junction.

In the course of the disease it is more than probable that some abnormal mobility of the part will set in: this is accompanied by such deformity as without due care and knowledge might be ascribed to subluxation, which is not the common, is indeed an unusual sequela of this disease. The distortion arises from one of two causes; either from the considerable relaxation of ligaments and capsule, produced by the great distending force of rapidly accumulating fluids, or from separation of the epiphysis. The diagnosis, especially if at a deeply seated joint or greatly swollen limb, is difficult.

It will be gathered from the above description that recovery is not so extremely rare an event as the earlier writers on this subject supposed. Of Demme's seventeen cases,[1] seven got well, and even though pus was formed in the affected articulation, it retained fair mobility. Nevertheless, the condition is one of great danger; recovery and convalescence extremely slow.

Beyond the peculiarities above described, the joint-affections secondary to acute ostitis have no anatomical characteristic requiring here especial mention. They fall under certain categories as already given (p. 201), which are treated each in its proper chapter.

I have now very briefly indicated the morbid processes which constitute acute ostitis, especially, if I may so term it, epiphysitis, and have spoken of more and of less violent attacks. The former belong to that mode of inflammation which is closely, indeed in our present state of knowledge inextricably, mixed up with phlebitic, septicæmic, or pyæmic phenomena. Such cases, the only ones observed or noticed by Chassaignac and Klose, led them erroneously to consider the one as necessarily involving the other. The fact is, however, that all grades of osteo-myelitis exist; and I have no hesitation in saying that many cases of very circumscribed and localized nature are occasionally entirely overlooked; the symptoms being obscure and sometimes impossible of interpretation. They end, if their course be favorable, in gradual readherence of the periosteum by granulation-tissue, sprouting from that membrane and from the subjacent bone; and by inspissation and enclosure within sclerosed bone of the intra-osseous pus deposit, sometimes also of a sequestrum. Such desiccated pus may remain thus encapsuled and dried up for many years, perhaps permanently. But when a subsequent disease (and bones thus weakened by old inflammations are very prone to new attacks) reveals to examination the ancient casified abscess, it is generally mistaken for a tubercle; and the more plausibly, if instead of one such blotch there be several small remnants of pus-deposit (chaplets of abscess, p. 202) scattered through the spongy texture. If, however, an ostitis, though still belonging to the less violent class, have yet gone far enough to set up large pus-deposits, and to have caused considerable necrosis, death, though delayed, may yet occur either by pyæmia, after joint-suppuration and deep-seated abscess in the soft parts, or by exhaustion, with lardaceous degeneration of kidney and liver. If the unfortunate patient escape with life it will only be after lengthened illness, separation of dead bone, and destruction of much tissue; he will bear to his grave a crippled and weakened limb; or perhaps, if the ultimate resort of surgery have saved his life, an amputation stump.

Symptoms.—The first sign of acute osteo-myelitis is generally a rigor, closely followed by severe pain in the affected limb. Occasionally a dull but rapidly increasing pain of a limb precedes all other symptoms by a

[1] Loc. cit.

certain number of days. Sometimes it is possible, sometimes impossible, to trace the attack to such cause as a severe blow or long-continued exposure to cold; sometimes it would seem that an endemic influence prevails,[1] and when such causality is to be recognized, diagnosis is facilitated. The pain is described by patients somewhat differently, either as burning, lancinating, violent aching, bursting or throbbing. It is accompanied by a very significant loss of power in the part; the limb remains utterly immobile; if the patient be told to get higher or lower in the bed, he does so with groaning difficulty, and either drags the limb by the trunk or lifts it with his hand. Independent movement of the member itself seems impossible. At this time, and for from three to eight days afterward, no change whatever can be detected by local examination; but the fevered state of the patient, with marked evening exacerbation, reveals serious disease. The temperature varies from 100° to 105°, or even more; it may have been preceded and accompanied by rigors, the pulse is at an average of 120 to 140, the tongue is furred, and appetite quite absent. There is entire sleeplessness, and generally delirium. At first the bowels are usually constipated, afterward vomiting and diarrhœa accompany the worst cases.

Some time within a week after the appearance of these characteristic symptoms local swelling becomes manifest; it is of doughy consistence and œdematous near the surface, but hard beneath; the induration ceases in a hard, sudden edge—the limb beyond this being to touch normal, or nearly normal. The tumefied part is very tender on deep pressure; but this tenderness ceases at the above-mentioned edge, as sharply and as suddenly as the swelling itself. This abrupt line of cessation is a very marked symptom upon which Chassaignac laid great stress, and very rightly, even although it may occasionally be absent. For some days, even as many as from five to nine, after the first appearance of tumefaction there is neither change in the color nor in the local heat of the skin. This change, according to Demme,[2] only supervenes when the deep swelling, the periosteal abscess, has approached the surface. In one of the cases I have seen, the coloration when it came on was red, the surface glazed, and the veins strongly marked; the subject was very young; both Chassaignac and Gosselin[3] observed the same hue; but Demme, whose experience on this subject is large, says that as long as the acute œdema of the integuments continues—and in the phlebitic form it may last throughout the disease—the color is a dirty clayey pallor, on which the veins are marked out with more or less distinctness. Abscess is not generally to be detected till toward the end of the second week, but in some cases is earlier.

Altogether the disease, when thus fully developed, is distinctly recognizable; the pain and helplessness of limb, accompanied by well-marked pyrexia, preceding any swelling by not less than three, more often by five or six days; then the rapid advent of deep, hard tumefaction, usually with a sharp edge and evidently sessile on the bone—absence of coloration for several days after detection of swelling—form altogether a picture so different from that of phlegmonous cellulitis or erysipelas that mistake is hardly possible. But Chassaignac advises that for diagnostic purposes a wide incision should be made through the soft parts and periosteum to the bone, and that judgment might be aided by the presence of oil-globules floating in blots upon the surface of the pus. Such proceeding, merely for the purpose of diagnosis, is a somewhat trenchant measure, especially

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[1] Such appears to have been present in Klose's cases.

[2] Loc. cit., p. 245.

[3] Arch. gén. de méd., November, 1858.

as oil-globules may be present in certain other diseases. Whether such aid to diagnosis is to be entirely rejected depends upon whether it be a valuable or injurious adjunct to treatment, a matter to be considered in the sequel.

One of the results of osteo-myelitis, namely, separation of the epiphysis, is not of itself a phenomenon dangerous to life ; but the disease producing it may by its virulence be necessarily fatal, and may receive a further lethal impulse from such occurrence. This destructiveness corresponds roughly but pretty accurately with the rapidity with which diastasis is produced. In the severe osteo-phlebitis observed by Chassaignac, Klose, and J. Roux, the epiphyses separated about the tenth or twelfth day. The sudden assumption of a new abnormal posture, and the deformed appearance about the joint, first aroused suspicion of the fact. In such cases the soft tissues are very liable to become gangrenous, and to permit the protrusion to some little distance of the ragged, brown-green, and semi-putrescent shaft-end of the bone.

In other cases[1] separation was delayed until much later, viz., up to the 40th or 55th day ; under such circumstances it may be, as I myself have seen, only partial.[2] The symptoms are similar to fracture at a later age, that is, after the epiphyses have joined, for it need hardly be pointed out that diastasis can only occur at an early period of life. Distortion, which careful examination by eye and touch will show not to arise from dislocation ; abnormal mobility, while the shape of the joint can be felt to be unchanged by the movement—*i.e.*, the relative position of the joint-ends remains the same ; while abnormal lateral movements near a hinge-joint, such as the knee, are enforced, there will, for instance, be no divulsion of joint-surface, no opening and shutting of the articulation. The truncated shaft-end makes pressure from within toward the skin, giving rise to a certain amount of prominence, which may be felt to be different in shape to that of the joint-end. These peculiarities can be much more easily made out in a subject whose soft parts are normal, than in one whose tissues are swollen by suppuration and œdema. Moreover, a minute knowledge of the shape of diaphysal and epiphysal junctions in different bones and at different periods of life greatly aids diagnosis. Nevertheless, in the particular conditions whereby osteo-myelitis may be recognized, the attendant naturally looks for diastasis ; therefore, if any distortion and abnormal mobility come on, he will hardly fail to recognize its cause, more especially since in all but very young subjects, babies in fact, some crepitation, in part hard, in part soft, is present. Not unfrequently also a sinus or abscess—opening leads a probe direct to the line of separation : occasionally the edges of the disjunction at one part (diaphysal) or the other (epiphysal) can be felt. It should be known, though the matter is hardly connected with my present subject, that not merely do joint epiphyses, but also muscular apophyses thus become separated from the shaft.

Affection of the joint lying near the osteo-myelitic focus manifests itself in different ways. Chassaignac was not correct in imagining that it always assumes a violent suppurative character ; moreover, he only mentioned that form which is directly induced by contiguity to the bone disease. If, how-

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[1] Demme, l. c. ; Roser, Die pseudo-rheumatische Knochen und Gelenk-Entzündung, Archiv für Heilkunde, 1865.

[2] It is well to point out that diastasis may occur from other causes besides osteo-myelitis, for instance, suppurative periostitis, even suppurative synovitis may produce it in those bones whose epiphysal line lies within the capsule of the joint ; traumatic diastasis is of course well known to every practical surgeon.

ever—and this I have observed when the patient is between the third and sixth year—the disease originate in injury, a tolerably well-marked simple synovitis may precede a graver affection. Later in life, when exposure to cold has produced the disease, a sharp rheumatic synovitis may first arise and will tend to distract attention from the earlier symptoms of the osseous malady. The mixture of the two diseases is indeed sufficiently perplexing, for the surgeon having in his mind a synovitis, perhaps not markedly severe, sees in that malady not enough to account for the severe pain and the great pyrexia, especially as in the first few days of the more important disease, the joint may evidently be getting better. Again, a less early, but still early, synovitis, of rather a slight character, may be caused by extension of inflammation from the periosteum, while that membrane, only just commencing to feel the force of the disease within the bone, is as yet but slightly involved. Such symptoms, combined with the signs and the history of an ordinary synovitis, may very excusably lead the surgeon to attribute the pyrexia and pain to a wrong cause, and to diagnose the case as one of acute suppurative synovitis. When the hip or shoulder is affected the distinction is more difficult than when the knee or other superficial joint is involved; the differential signs are as follows: The pain is differently placed; osteomyelitis, however near the joint, does not produce pain within it, nor in the spots characteristic of synovitis, but in the bone itself, a little distance from the articulation, even when the epiphysis is primarily involved. The joint is less swollen, and on its surface œdematous; it is also less exquisitely tender than a suppurating one; tenderness may indeed be detected over one of the joint-bones, but is quite or almost absent from the other; it often is more marked a little distance from the joint than over the synovial membrane itself. The surface is not red, nor are, in these early days, the veins upon it strongly marked. Lastly, the characteristic positions of severe synovitis are absent; the knee, for instance, does not become more and more flexed, but remains almost straight, until after the fifth or eighth day, the period when the deep hard swelling of osteo-myelitis occurs. These are very peculiar conditions; the patient has a strongly marked pyrexia of a somewhat typhoid form, and complains of severe pain in an extremity—a joint in that limb is affected, but to a degree only which cannot possibly account for the general disturbance. The pain points to local disease, the violent fever marks its severity, but the joint-affection is not severe; this peculiarity of symptoms can be interpreted in but one way: the surgeon is at once led to regard the bone in the neighborhood of the joint as the seat of disease.

The secondary joint-affections, those depending directly on the osteomyelitis, have been described as of five orders, and any one, even the mildest of these, may be present when the bone is already suppurating; they only arise after the bone disease has been for some time established, and then in a gradual, almost imperceptible manner. The first three manifest themselves by the ordinary signs of fluid in the articulation; but it will always be very difficult to verify a transition from mere serous to purulent synovitis, since one of the chief symptoms of this change, viz., pyrexia, is masked by fever already existent. The diagnosis is, under the circumstances, unimportant, but should the surgeon wish to make it, an aspirator needle will readily solve the question.

Pyæmic pus-deposit manifests itself by the general signs of that dyscrasia rather than by any especial local ones; if the joint have not been previously affected it will of course swell after the manner described at p. 65. The joints of the limb itself, especially the joint near the original disease, are

less likely to be attacked by metastatic abscess than distant ones. In multiple osteo-myelitis such condition of a distant joint is the first sign that a new focus of disease has formed.

Acute suppurative synovitis, as a sequela of acute ostitis, unless under mistaken forms of treatment, is rare ; its symptoms are very distinct. Occasionally, such disease is ushered in by considerable decrease in the pain above the joint, owing apparently to some decrease of intra-osseous pressure —pus having escaped into the synovial cavity. This slight remission is followed by a renewal of rigors, which have for some days been absent ; then follow fresh pains, a new rise of temperature, rapid swelling of joint with redness of surface, and the other symptoms described at p. 203. The usual form of joint-suppuration in these cases comes on slowly, and is much masked ; the punctured openings, one or more in the cartilage, being filled by granulations from the cancelli, let pus pass but slowly into the joint ; hence, already inured to its presence by previous thickening and hardening of the synovial tissue, the suppuration is less stormy than under other circumstances ; it is therefore less pyrogenous, and in a given time less destructive ; but the same signs as those above given, though not so severe, will show the character of the disease.

Treatment.—When, in 1854, Chassaignac read before the Académie des Sciences his since classical papers on Osteo-myelitis, he also described the treatment, namely, early and wide incision down to the bone. Only two of his cases recovered. Klose, J. Roux, Gosselin, and others followed in the same line, and with very similar results. Whether, after this incision, amputation was or was not performed, the patients, as a very general rule, died.

In 1862, Dr. H. Demme, of Berne, published his paper on this subject ;[1] he gives the detailed history of seventeen cases. In the first four Chassaignac's recommendation was carried out ; they died on the 15th, 34th, 76th, and 138th day respectively. In the other thirteen cases no early incisions were made ; of these every one recovered.

It is, doubtless, sad and humiliating to consider that in memoirs undoubtedly careful, and founded on minute observations, excellent surgeons should have inculcated and inaugurated a treatment that, in great degree, produced the sadness and blackness of the picture which they drew. But there can be no doubt of the fact that incisions which opened out to the air, and its floating influences, veins already inflamed, and prone to septic action, admitted that particular morbid agency which should be carefully excluded, and which there can be no doubt were, in many of these cases, the cause of death. The fundamental axiom of Dr. Demme's treatment is therefore to avoid making any opening whatever, during the more violent phase of the malady which, as previously stated, passes away some time during the second week, leaving a subacute and less dangerous condition.

Dr. Demme, moreover, supports this view upon theoretical grounds, pointing out that the malady and the abnormal pressure lie within the bones, beyond the reach of the knife, and that merely to cut down to its surface cannot relieve the evil ; also, that the wide and deep incisions so strongly recommended by the authors already frequently named, give rise to very considerable bleeding, and that in the depressed state of the patient it is absolutely necessary to spare his powers in every way.

During the brunt of the febrile condition he recommends therefore a somewhat expectant treatment. The diet to be nourishing, but light and unexciting. The use of morphia and other anodynes is absolutely necessary.

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[1] Loc. cit.

Beyond this, the medicinal treatment is to be as simple as possible, though naturally, in the course of such a malady, various indications for different forms of medication may arise, such as diarrhœa, constipation, icterus, pleural complications and the like.

For local treatment the most necessary condition is entire rest of the limb, which should be somewhat raised. An Amesbury splint, for instance, swung in a Salter's cradle, or the suspension arm-splint (see p. 55). Any local bloodletting, poultices, etc., are to be repudiated. Two applications more especially seem to him commendable, viz., ice in bags kept constantly on the limb, and iodine painted on every two days. Of the former he has had no personal experience.[1] The latter is his sheet-anchor; indeed, Dr. Demme speaks of this application not merely in this disease, but also in others, in terms which English surgeons will hardly endorse. He uses a very strong tincture, namely, of pure iodine, 60—68 grains to the ounce of nearly absolute alcohol (96—98 per cent.) ; this preparation is to be painted on till a blue-black color is produced, and always beyond the limits of the disease. The part then is to be covered in cotton-wool or wadding, or in a compress steeped in oil. If it should blister, acetate of lead, alum or an opium lotion is to be applied.

If any abscess come near the surface, it may be opened by a small valvular incision, or by a trocar ; the surgeon will, of course, take this opportunity of confirming his diagnosis by looking for the characteristic circles of oil floating on the pus. With this treatment we must wait for the gradual decrease of pyrexia and of inflammatory signs, which usually come on in the second week.

The subacute phase of the disease, when fairly developed, is the signal for incisions, or at least for an opening through the skin ; the place must be determined by the proximity of pus to the surface. The scalpel gives rise to much loss of blood—the actual cautery, or chloride of zinc, is, according to Demme, preferable, and even when the knife has been used he recommends subsequent cauterization. Afterward, the wound is to be washed out with injections of chlorinated water and iodine ; or dressings with plugs soaked in tincture of iodine, so as to convert the soaked and dying areolar tissue into a dry slough. If any symptom indicate that within some part of the bone a collection of pus has taken place, the trephine may with advantage be applied.

Thus far I have given the views of Dr. Demme the younger as opposed to those of Chassaignac, Gerdy, and others. At the same time I must submit that in certain cases tension is so excessive that incision, unless he would allow gangrene to come on, is forced upon the surgeon. Moreover, we now have means whereby the advantages of opening may be attained, without the fear of putrefactive changes ; and of the only cases which I have had to treat since I commenced the antiseptic method, two got well rapidly, after a limited incision followed by free tearing of the periosteum ; one died, amputation being declined, of lardaceous disease and marasmus. I would, under our present advantages, incline to follow this course. Of the two cases which I treated after Dr. Demme's method, the more severe one died, the other recovered, but with considerable necrosis and a stiff, somewhat deformed, joint. As to the general treatment, plentiful support, large doses of quinine, or, under fear of purulent infection, the sulpho-carbolate of sodium (see p. 81) are necessary. Morphia most conveniently as a hypodermic injection is, as already stated, essential.

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[1] My own has been highly unfavorable.

Even after the patient has convalesced, certain very troublesome conditions generally remain behind, and may continue for years. Sequestra will probably be left, which, if large, may even prove a source of subsequent danger—if small, may keep open long, tortuous sinuses, leading outward through the skin, and maintain a continual discharge, with more or less of pain and lameness. Also, if the closure of veins by phlebitic thrombosis remain permanent, a very troublesome œdema, with solid effusion, impairs the function of the limb. These must be treated according to the circumstances of the case, and to the precepts of surgery, to inculcate which is not my present task. But I must point out that a bone thus weakened by an osteo-myelitis, is very prone to subsequent forms of disease, which we shall meet with in an ensuing chapter.

The management of diastasis is two-fold; the preventive and the curative. Every surgeon encountering the disease above described will be prepared for such occurrence; he will, however, remember that only in the worst, the osteophlebitic forms, are the epiphyses cast off in a rapid, almost sudden manner. That in general a groove more or less deep, and extending either entirely or partially round the bone, gradually invades the epiphysal junction more and more, until it is entirely absorbed, or until a check is put to the absorbing process. If any violent or sudden movement occur, while the formation of this groove is somewhat advanced, the lessened bond between shaft and joint-end will snap; while if by due care such occurrence be rendered impossible, the union may be maintained. The limb, then, in all these cases must be entirely immobilized, nor must even a slight chance of movement be permitted; care of course will be taken that the joint be put up in such position as will be most useful should the very probable anchylosis ensue.

When diastasis has taken place anchylosis is the best attainable result. The accident must be treated like a fracture, but even with more rigid maintenance of immobility and for a greater length of time. A false joint about the elbow may be tolerated, but one at the knee is a very grave misfortune, and years of splintage can hardly be called wasted if they at last overcome the trouble. As soon as the condition of soft parts permits such application, a plaster-of-Paris bandage, in which openings at the sinus mouths are cut, is the best form of support. Afterward a well-fitting mechanical appliance may be necessary.

As the diseases of joints combined with osteo-myelitis are of manifold degrees and kinds, so must the treatment be various. The primary malady, that which I have described as produced by the same cause as, but otherwise independent of, the osteo-myelitis, assumes the form of acute serous or suppurative synovitis, which sometimes even may be severe, and if it precede the inflammation of bone will engage all the surgeon's attention. The treatment of acute synovitis described at p. 38, which is here appropriate, will, in a certain number of cases, subdue the malady before or very soon after the manifestation of the bone disease. In other cases the two maladies arise simultaneously or nearly so; the primary joint-affection is very apt to persist long enough to mingle with a fresh and secondary inflammation, propagated from the bone. Under such circumstances very rapid and considerable exacerbation takes place; the symptoms are not so much aggravated as muffled and concealed by a more violent condition, hence a frequent difficulty in apportioning its just part to either phase of the treatment. I would recommend more especially, besides rigid rest, free vesication, either by the Spanish fly or the strong tincture of iodine, not over, but rather above the joint, and close watchfulness as regards tension of

parts. When the synovial membrane and the perisynovial tissues get full and tight, an incision should be made under the most rigid antiseptic precautions. A subcutaneous incision, unless we can be quite sure that the fluid is not pus, and unless the joint only, not the neighborhood, is tense, will either lead to extra-articular abscess, or will not relieve the condition.

Case LV.—Mrs. F. brought her baby, aged two years and three months, to the hospital, April 14, 1867. The child, though at the time very ill, was of fine, vigorous growth, and evidently of excellent constitution. The mother suspected, but could not affirm, that it had been let fall by a girl in charge about a fortnight previously—the symptoms appeared to have commenced eight days since. The right thigh was greatly swollen, red and shiny on the surface. The tumefaction was hard, on deep pressure the superficies œdematous, the red color disappearing on the place of pressure, and only slowly returning. The tongue was rather brown, the skin hot and dry, the child's manner oppressed and dull. Mr. Hancock treated the child by poultices and purge, support and stimuli.

April 18th.—The limb, which previously had been bent up, was found to be straight, evidence of an abscess appeared in the lower third of the outside of the thigh; this was opened, the finger passed in, and the deeper parts torn away. A good deal of pus, with oil-globules floating on it, were thus evacuated, and I felt the femur bare throughout the whole extent of the wound.

April 20th.—The limb was found in a very strange position, the knee hyper-extended, hollow in front above the patella, protuberant in the popliteal space. The tibia was not in a straight line with the femur, but was directed considerably outward. The child was apathetic, almost comatose.

April 23d.—Early on the morning of this day the child died.

April 25th.—Leave to examine the limb only was with difficulty obtained. The skin being carefully removed, the saphenous vein was found to be choked with thrombus, as far as the saphenous opening. The tissues outside the *fascia lata* were somewhat infiltrated by serum of brownish hue. This fascia was divided from knee to groin. The muscles were of remarkably dark color, the interspaces filled with serum in the upper parts; lower down, *i.e.*, nearer to the knee, this fluid gradually changed to a brownish and then blood-stained pus. The veins all contained clots, some of which were evidently old and broken down, being of a dusky yellowish or fawn color. This was more readily made out in the larger veins, therefore especially in the femoral, but they were all apparently in the same state.

The periosteum was separated from the femur in the lower half of the bone, which was rough and necrosed, the interval left being occupied by thick, rather grumous pus, and oil or liquefied fat. On the inner and front part of the diaphysal end, the bone was rough and excavated, there being a hollow as large as half a filbert, with very uneven surface, looking as if it had been gnawed. This caries extended along the epiphysal junction, which was quite destroyed except at the back and outer part, where some cartilage-fibres still kept the epiphysis attached to the shaft. The epiphysis itself was roughened by the deposition of small, uneven osteophytes, but though inflamed was not necrosed. I could not, owing to the promises exacted by the mother, remove the femur, but made a longitudinal section with the saw, so as to open the medullary cavity from the end of the diaphysis upward for about four inches. This cavity was filled with pus—liquefied medulla and blood extravasations; these last did not mingle with the other fluids, but were clotted in different parts, so as to give a singular

coloration; varied of yellow, dusky and bright, brown verging into green, and purple. The inner layer of bone-tissue, that forming the wall of the medullary cavity, was here and there soft—rough-looking, as though worm-eaten; occasionally a larger hole than usual contained a soft pultaceous plug.

Case LVI.—John C., aged thirteen, received, February 2, 1871, a severe kick on the outer side of the left thigh while playing foot-ball. He had, for some days, a good deal of pain, in about a week this seemed better; but he felt ill. On the 12th or 13th he tried to run home through a shower, but this hurt him so much that he stopped, and had to go slowly, and got very wet. Three or four nights after he was awoke in the night with violent pain and headache, was sick next day; the limb was swollen.

February 17th.—He was brought to the hospital. The outer side of the thigh was baggy with fluctuation, the whole limb swollen; although the superficies was soft, and the case seemed like an abscess under the fascia lata, stronger palpation showed that there was a deeper, harder swelling, sessile on a portion of the bone. The limit of this indurated part was very defined; below being about two inches above the patella; above about the junction of the upper, with the middle femoral third. The limb lay quite straight on its back; he did not move it when told, though evidently he tried to obey. I asked him to get up higher in the bed, and while doing so he dragged the limb along as though it were quite lifeless. There was no redness, but rather a pallor of surface. Several tortuous, mesh-like veins were strongly marked above the knee-joint, and running up the inner side of the limb. Tongue brown and dry; pulse, 130—140, small; temperature, 104.8°. Occasionally, especially at night, the boy had a muttering form of delirium; sometimes very restless, but more commonly was dull and apathetic. He was, on admission, either already affected with pyæmia, or on the verge of being so. The abscess was incised only through the fascia lata, a great quantity of pus escaped; it contained no oil-blotches, but had a somewhat offensive odor; the cavity was mopped out with chloride of zinc solution, and the wound dressed with permanganate of potash.

February 21st.—Very plentiful discharge from the wound; the pus contains some oil. On passing in my finger I felt the periosteum baggy and fluctuating; also I detected a small opening, into which I passed a strong steel director, and tore the membrane almost to the extent of the outer opening. The limb looked rather deformed at the knee. A light MacIntyre splint applied, limb swung. The pus, which flowed freely, contained a quantity of oil. The boy's health was much in the same state; the thermometer, however, marked a few decimals less temperature.

February 24th.—The swelling of the thigh had decreased; the bone could be felt bare and rough as far as the finger would reach. The boy is more restless, mutters continually, sleeps little, but seems often comatose. Some diarrhœa; stools very offensive and dark.

February 27th.—The limb decreased in size; but with a singular yellow-gray hue over the whole thigh. The boy, however, was worse, his breathing very quick and shallow; tenderness over the abdomen. Pulse almost too quick to be counted; temperature, morning, 100.2°; evening, 105.1°.

March 1st.—Death took place in the night.

March 3d.—*Post-mortem.* Secondary pyæmic deposits in both lungs, but chiefly in the left, a few secondary abscesses in the liver—a low form of peritonitis—intestines contracted. Brain pale, with much serum in cavities, no abscesses, a little arachnitis in Sylvian fissure. The thigh infiltrated with turbid serum and pus, the muscles dark and softened, breaking under

pressure with the finger. All the lower half of the femur bare, the periosteum filled with thick grumous flocculent pus, offensive and of a greenish hue. The lower end of the diaphysis was of a deep brown color, and the neighborhood was saturated with oil; the epiphysis was quite detached, and the truncated end of the shaft was very rough; from this darkened part of the bone the necrosis seemed to have spread upward, but much more extensively on the outer than on the inner side—the line of attachment of the periosteum being very oblique. On splitting the bone, lengthwise, with the saw, one opened close to the lower part of the shaft an intra-osseous abscess, and when the section was complete this was found enclosed in fairly smooth osseous walls, of a green, almost bright green, hue, which on the section edge could be seen to merge into brown toward the outer surface.

The veins of the limb were mostly choked with thrombi and broken-down clot.

Case LVII.—Emma S., aged eleven, admitted under my care into Charing Cross Hospital, November 5, 1875. She was taking home work for her mother; met with no accident that she knows of—but the distance was considerable; she was very tired, and had to sit down several times; came home late and had no supper; felt very bad, and did not sleep. Had to get up next morning, but could hardly walk from pain in the leg. This happened a week before she came to the hospital.

She was a small, ill-nourished girl, of feeble constitution, not properly fed, and evidently hard-tasked by her mother. The left leg was swollen and very painful; the swelling was chiefly just below and about the knee-joint, where considerable deep induration could be felt, but the whole limb was œdematous and marked by a network of tortuous veins, except at a spot inside the tubercle of the tibia, which was red; the limb was of a muddy yellow color. It was quite helpless, as though paralyzed. Her tongue was white and coated slightly brown by the raphe; pulse, 125; temperature, 103.8°. Support and stimuli were ordered; also a sufficient purge. Hypodermic injection of morphia. Limb to be wrapped in a turpentine stupe.

November 8th.—The limb was more swollen; the knee-joint fluctuating. A small incision was made through the periosteum on the inner side of the tubercle, where the red spot above-mentioned had become of a dusky color, pus escaped. The finger passed in felt that the bone was bare, and that the periosteum was detached for a further distance. I followed with finger and knife this detachment, at last as far down as about three fingers' breadth from the ankle-joint. This was done under antiseptic precautions, a piece of gauze was placed in the wound, and dressings after that method applied; the limb placed on a MacIntyre, and swung in a Salter cradle.

November 10th.—The leg less swollen and of a better color; veins less strongly marked; the knee more swollen and painful. Wound discharging freely, but looked healthy; temperature on night of 8th and 9th, 102.4° and 101.2° respectively.

November 13th.—Leg much better; knee more swollen and fluctuating; tried to withdraw fluid by aspirator; only got a drop or two of turbid serum or liquor puris; passed a long tenotome from upper corner of tibial wound under the skin along inner margin of patella, and, while withdrawing, opened synovial membrane very freely; an abundance of flocculent pus flowed away; put into wound a small drainage-tube, directed it to be shortened by one-half on the third day.

November 16th.—Girl very much better; temperature the last two nights under 100°; tongue cleaner; begins to eat well.

February 4, 1876.—The patient went on uninterruptedly well. In the beginning of January passive movement was tried on the knee, but she had, somewhat to my surprise, very little restriction of motion and scarcely any roughness, which soon disappeared. The wound over the tibia had healed, leaving five sinus mouths, which led to bone. She went to a convalescent home, with orders to return if sinuses remained open.

May 2d.—Returned as agreed, only one of the sinus mouths had closed, the rest led straight to bone. One high up, one about upper fourth, and one quite low down in the leg.

May 4th.—Under chloroform, and antiseptically laid together the upper sinuses; found periosteal bone rather thin and soft enclosing sequestrum; cloacæ here and there. Had to lay open the whole of the old wound, turn new bone forward and backward with periosteum, cut through the old tibia above and below and remove it, clearing away at either end until coming to live osseous tissue; the dead did not reach quite to the lower, but fully to the upper epiphysis. The girl made an excellent recovery; the bone being reproduced a little thicker and larger than the normal one. The sequestrum is in the Museum of the Charing Cross Hospital.

Case LVIII.—Thomas F., aged five months, was brought to me at the Charing Cross Hospital, June 15, 1878, with greatly swollen shoulder and arm. The child had been quite healthy until five days ago—when it was very fractious—screamed if in dressing it the arm was moved; an injury was suspected by the mother; only, however, because she could not otherwise account for the condition; temperature, 103.4°. She refused to come in with the infant or to leave it, it was treated therefore as an out-patient.

June 20th.—The child brought again; arm more swollen; child pale and apathetic—mother stayed in with the infant—which, however, was evidently dying, and it succumbed in the evening of the day after.

Post-mortem Examination.—With difficulty I obtained permission to examine the joint only. This was laid open by a V-incision. The long head of the biceps had disappeared; the synovial membrane was full of thick creamy pus, but was only slightly reddened. The cartilage was full of holes, larger and smaller, all of which led straight to the osseous nucleus, and from all of which pus flowed. The cartilage was cut through with a knife, and on opening it the nucleus fell out of a cavity, still partly full of pus. All the cartilage was abnormally vascular, but the immediate lining wall of the cavity was excessively so; and in parts the vessels formed a sort of lining not unlike the *pia mater*. The nucleus itself was pale yellow, friable and necrosed.

CHAPTER XI.

CHRONIC OSTITIS.

Pathology.—Ostitis is described as of different sorts, according to the condition which produces it; thus there are the traumatic, rheumatic, strumous, syphilitic, and some other varieties, any of which may be more or less acute, more or less chronic. Moreover, though fundamentally similar, the action is rather different according as it occurs in the hard solid texture, or in the cancellous tissue of bone; and this latter presents in early life, while the part is still chiefly cartilaginous, certain peculiarities, which, for our present subject, are of great interest. It will be remembered that inflammation of the shaft of a bone, though it may occur at all ages, is unusual (save as acute osteo-myelitis) in early life. Ostitis of spongy tissue, if it affect a short bone, is common to early and adult life; but affecting the epiphysal end of a long bone, is, as a primary disease, almost confined to childhood.

Even further distinctions must be drawn according to the particular histological changes which inflammation produces. I do not mean the termination of the process, as in caries or necrosis, but the forms of the action itself—these are chiefly the rarefying or osteoporotic, also called malacissans, *i.e.*, productive of malacia; and the indurating process called osteo-sclerosis.[1] Our subject will best be elucidated by first describing the rarefying type as it occurs in spongy, then in solid portions; afterward the condensing variety. Furthermore, we must examine the peculiarities of the process arising in immature short bones or epiphysal ends; lastly, a few words must be said about the terminations of inflammation.

A section made with a fine sharp saw through a cancellous bone, in an early state of inflammation, shows, among the yellow toned or slightly pink medulla, spots or blotches of redness, from which oozes, as a rule, some oily, creamy serum, which generally moistens and adheres to the instrument. These spots are of greater or less size according to the severity of the case, and in some degree also according to its age, for that which a few days previously might have been found as a speck may at the period of section have increased to a great blot; it may, if the inflammation be quite diffuse, involve the whole epiphysis; or, if sharply circumscribed, may be surrounded by a more or less complete ring of cancellar tissue, rather whiter, harder, and more solid than the norm. The red blotches are sometimes, but this in the more rapid, especially in the traumatic form, speckled with little spots of extravasation; in such case there is more than the usual amount of serum, which also is blood-stained. Section, made a little later, displays besides a deeper coloration a singular enlargement of soft parts,

[1] I shall here confine myself to these forms, although in reality there are several others, as yet but little understood and very difficult of elucidation; thus ostitis deformans of Paget (Med. Chir. Trans., vol. lx.). Arthritis deformans, probably rachitis, are different forms of slow inflammation of bone-substance.

manifested by their protrusion beyond the section-surface of the cancellar walls ; that is to say, that out of each cancellus, cut across by the saw, there pouts a little plug of soft material, which previously was compressed within that cavity. As such projection takes place out of each cancellus all the affected part feels to the finger drawn across it like a piece of velvet ; and the bone is not detected at all unless pressure enough to put aside or crush down these excrescences be made. This condition depends upon the fact that under the influence of inflammation the contents of each cancellus becomes too large for the cavity. Part of this contents is a serous or serosanguinolent fluid ; but in this form of ostitis the bulk of it consists of granulation-tissue formed by proliferation of the lining membrane. In a little while the cancellar walls begin to lose their earthy ingredients, to become soft and flexible, and then to be absorbed, getting thinner and thinner until throughout the area of inflammation they form a wide-meshed reticulation of very attenuated bone striæ ramified through the newly formed granulation-tissue ; or may altogether disappear, leaving throughout the district of inflammation, or in the most diffuse cases throughout the bone or epiphysal end of the bone, a mere soft fleshy mass. More frequently it happens, before this phase is reached, that some portion of the inflamed tissue suppurates, ulcerates, or becomes carious ; or again, that some of it dies and is slowly separated from the yet living part. Of these processes—abscess, caries, and necrosis, the first must needs be in the substance of the bone ; caries, though generally on the surface, is sometimes in the internal parts. Hence both it and necrosis receive different names according to situation, which may be on the surface (superficial), or may involve a portion of both surface and deep parts (partial), may only effect deep parts (central), or the entire bone (total).

The very close resemblance between inflammation of a cancellous bone and the non-phlebitic osteo-myelitis of a long bone must not be overlooked. In this latter, the simply constructed tubular membrane is inflamed, while the osseous wall becomes absorbed and thin ; in the former the far more complicated membrane, divided and subdivided into innumerable cavities and partition walls, also becomes hyperæmic, granulates, perhaps suppurates, and each bony wall yields to a process of more or less gradual absorption. Histologically the action in every, even the minutest, cancellus is the exact counterpart of the whole ; whether simply in other such spaces, or in the much larger medullary cavity of the bone.[1]

If, on the other hand, we examine the fully developed disease as affecting the solid parts of bone, we find in the living subject the deeper layer of the periosteum swollen red and easily separated from the underlying surface. The membrane comes away either clean, *i.e.*, bringing no bony flakes with it, or if the case be further advanced, the softened outer layers of the bone, those consisting of concentric plates (p. 3), adhere to the membrane as a pultaceous mass, and leave an irregular columnar surface behind. If the bared bone be incised with a strong knife, or sharp chisel, it will be found to cut as readily as a piece of boxwood, the shavings, like those from the wood, curling up as they fall away. The fresh surface is pink, bleeds pretty freely, and may be seen even with the naked eye, but

[1] Clinically, the two maladies are less alike than they are histologically. But cases on the operating-table occasionally show that years before an osteomyelitis had, unsuspected, produced a condition of bone for which the patient now seeks relief—be it localized abscess, necrosis, or other such state ; inflammation of the medullary membrane not being always that diffuse and violent process which the term osteo-myelitis is generally taken to mean.

better with a simple lens, to be lined and spotted with bright red grooves and pits, from which the blood flows, and which are in fact greatly enlarged Haversian canals that have been cut through in different directions, and which contain hyperæmic Haversian vessels, besides other things to be immediately named. These channels and pits have been formed at the expense of the solid substance, they cause the bone to be porous and sieve-like (osteo-porosis); and as the remaining substance, the septa between the canals, are at their edges also softened, malacia may be superadded.

FIG. 23.—Ostitis (Howship).

Natural size.

If now these two accounts of ostitis occurring respectively in the solid and in the spongy parts of bone be compared, it becomes evident that the action is the same in both, namely, certain membranes, normally present in bones, in the one case lining cancellar cavities, in the other Haversian canals, etc., increase and enlarge at the expense of the solid tissue, which becomes softened, disintegrated, and at last absorbed. Portions indeed die; if they be small they mix as grit with the new membranous formation and their secretion—*caries:* if larger, they lie as visible masses, or *sequestra*, and the process is termed—*necrosis.* If the new soft tissue formed by this increase of the normal membranes be examined microscopically, it will be found to consist of cells, among which in spongy bone are many giant cells[1] bare nuclei, and granules traversed by long, slender, and fine-looped vessels. In fact, the tissue, though in certain points it resembles fœtal medulla, is simply granulation produced by cell-proliferation from the normal membranes of the bone.

A point very interesting to the scientific pathologist is the mechanism and chemistry of the inflammatory bone absorption, which enlarges the Haversian canals, or the cancelli as the case may be, and thus makes room for the proliferation and granulation of the soft tissues. The obstacles to histological investigation are enormous, and will be indicated immediately; the difficulties, in obtaining a clear comprehension of the processes, arise in the fact that, when inflammation attacks any soft tissue, elasticity of the part allows sufficient area for hyperæmia, effusion, and cell-proliferation. But such an amount of space is hardly procurable in a tissue so hard as bone; another hindrance to a clear view of the process lies in the double

[1] The presence of these cells gives the granulation-tissue a striking resemblance to infantile medulla; they are always present in normal or abnormal tissues, which lie in contact with bone undergoing absorption, whether natural, as in change of form, or diseased as in myelitis. Kölliker terms these cells osteo-clasts, a term which, as it imputes an unproven function to a certain organism, ought to be rejected, lest in a few years we have to invest them with a new name.

constituency of bone, viz., cartilage and insoluble, hence in that state non-absorbable lime-salts. The key of the whole question lies in the explanation of one particular phenomenon, viz., the mode of formation of those rounded or oval excavations, so well known by the name of my predecessor at the Charing Cross Hospital as "Howship's lacunæ." These excavations, sometimes seen as smooth grooves, sometimes as rounded pits lying close together, but separated by ridges or pyramidal projections, are seen on the surface of necrotic or carious bone, also at the margins of Haversian canals encroaching into the osseous tissue proper (see Fig. 23)—in fact on any normal or abnormal surface of inflamed bone. They are usually, though not always, filled by soft granulation-tissue ; and represent spaces from which the bone has disappeared by a process of solution and absorption. The agency productive of these effects is the point in question.

One school of observers, Virchow,[1] Foerster,[2] Rokitansky,[3] to which also, in Germany, I am considered to belong,[4] believe or have believed, that the Howship's lacunæ are hollowed out by changes, which take place in the bone-substance itself, through certain actions of the lacunar cells. To put the gist of the matter in the shortest possible language, it is asserted by Virchow [5] that bone, like other connective tissues, consists of cellular elements and of intercellular substance (*Grundsubstanz*), and that each cell governs and maintains a certain territory of the latter material. The boundaries of each government are lost or obscured during health, but in pathological conditions, such as inflammation, they reappear, by the simple fact that one district will become the subject of an excited and enlarged lacunar cell, therefore changed in certain ways or converted into a different tissue, for instance, into granulations ; while neighboring territories remain normal and hard. Therefore, under this interpretation, the Howship excavations are the gaps whence certain cell-territories have, through some influence of the bone-cell, softened and disappeared along a given surface, as that of a sequestrum, or on a surface of living bone, from which a dead portion has separated, or deeper, as in a burrowing caries. Virchow, Foerster, and I have given representations of inflamed bone with lacunæ thus enlarged. But, be it observed, Virchow expressly states that all excavations on the surface of dead or inflamed bone are not thus produced, but only those which in size and shape correspond to the cell-territory—for Stanley, Erichsen, and Von Langenbeck have shown that the ivory pegs used to promote the healing of an ununited fracture (ivory is a structure without cell districts), become excavated into large and small gaps, or lacunæ, very like those of Howship.

Another school of morbid histologists, among whom Billroth stands pre-eminent, considers that throughout the process of inflammation osseous tissue is merely passive, and incapable of inflammatory action. That great observer says : "Is there, moreover, such a thing as acute inflammation of osseous tissue ? If we assume as our starting-point that enlargement of vessels, infiltration by cell-elements and serous infiltration of the structure, combined in relatively various proportions, constitute the necessary conditions of acute inflammation, we must deny the possibility of such an action in compact, perfected osseous tissue ; for all these processes in the hard

[1] Cellular Pathologie, p. 521, fourth edition.
[2] Atlas der mikroskopischen pathologischen Anatomie, Taf. iii., fig. 5.
[3] Lehrbuch der pathologischen Anatomie, third edition, vol. ii., fig. 8.
[4] Volkmann : Zur Histologie der Caries und Ostitis ; Langenbeck's Archiv, vol. iv., p. 443.
[5] Loc. cit., p. 18.

cortical substance of a long bone are not conceivable."[1] He proceeds then to show that absorption of bone is simply effected by the granulations which arise from the membrane lying in Haversian canals, and which probably secrete, as solvent of the lime-salts, lactic acid;[2] that the rounded excavations (Howship's lacunæ) receive that particular form, not from any action of a cell upon its territory, the existence of which he denies, but by simple modelling upon the rounded form of absorbing granulations, through whose agency alone bone can be thus dissolved. He supports this view by reference to the erosion of ivory pegs, artificially introduced. The examination of one, that he had thus used, disclosed pits, grooves, and markings, closely resembling Howship's lacunæ.

Volkmann occupies between these two opponents a middle place. His paper, above referred to ("The Histology of Caries and Ostitis") is well worthy of study. He has brought many new facts to light, more especially as to the rapid perforation of solid bone by arteriferous canals. My point of view has, I confess, also somewhat changed ; it is impossible to follow on preparations, the cogent reasonings and clear descriptions of Billroth, Lieberkühn and others, without perceiving, that, in many sorts of ostitis, the granulation from soft parts plays a very important part, but not, I believe, the whole drama, for it appears to me that Billroth is far too exclusive, and that even his reasoning above given is open to grave exception. Why, for instance, must enlargement of vessels, cellular and serous infiltration, be regarded as essential to acute inflammation, and why are these inconceivable in compact bone-tissue ? Cartilage, as I have elsewhere pointed out, is occasionally acutely inflamed, yet even in the most intense form we find no vessels in the structure itself, and what cellular infiltration exists originates in the very cells of the tissue. Certainly, it appears to me that enlargement of vessels is not only conceivable, but demonstrable, in hard bone-tissue (see Fig, 23). Let us also consider the first step in ostitis affecting a small tract, through which runs an Haversian vessel. Can this first step be granulation within the canal ?—if so, there must either be room for its formation—therefore room for enlargement of the vessel and for serous effusion—or there must be no room, and the granulation, if formed at all, must compress the vessel and cause death of the bone. Or if granulation from the cells of the Haversian membrane can arise, and then by bone-absorption make room for itself, one fails to see why the cells of the lacunæ should not act in the same manner. But if granulation be not the first step, if it be delayed until some absorption of the Haversian wall have made room for it, then there is some material other than granulation endowed with the power of absorbing bone. Moreover, it must be observed that the enlarged Haversian canals are at first always smooth-walled, as Howship pointed out, therefore cannot be moulded on granulation surfaces ; hence the enlargement is not due to such growths. The lactic acid theory, although very facile and plausible, rests upon the results of one very peculiar case ; for, as an almost invariable rule, the secretion of bone-granulations is alkaline.

If with Billroth we totally deny the action of lacunar cells, we shall have to explain, not so much how ivory pegs are eroded, but rather why they are so very seldom attacked. It has been my fate to use twenty-seven pegs for old ununited fractures, and I have seen but one (now in the Museum of

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[1] Die allgemeine chirurgische Pathologie und Therapie, p. 416.

[2] Ueber Knocken-Resorption, Langenbeck's Archiv, vol. ii., p. 126; Lehrmann's Physiolog. Chemie, vol. iii., p. 26.

Charing Cross Hospital) which did not come out of the granulations as smooth as it went in. Is not the erosion therefore indicative of some peculiarity in the sample of ivory? Again, why should dead bone resting upon granulations be so much more slowly absorbed than living bone—so slowly, indeed, that although the minute anatomist may be able to find here and there the traces of rodent action, yet for the practical surgeon, sequestra are, to all intents and purposes, incapable of absorption. While live bone—and life should preserve against influences from without—is frequently largely dissolved, therefore such solution is more or less a vital act, not a mere passive yielding.

Although I controvert the views of such a man as Billroth with very great diffidence, yet I cannot but think that he has been somewhat misled by two circumstances—by his view of the constitution of bone and by his method of investigation. He appears to me to separate, in a manner far too trenchant, the membranous and the osseous constituence of bone, to conceive bone as consisting of separate and isolated islands of solid tissue, divided from each other by channels (Haversian), containing vessels and cellular tissue, which have nothing to do with the bony parts, save to convey nutriment to them. I cannot look upon bone in this wise ; as elsewhere stated (Chapter I., p. 3) I consider the Haversian lining membrane to be continuous with the lacunæ and canaliculi ; that this branched structure is the unossified portion of a tissue, the other portions of which have received a deposit of lime-salts ; that this non-calcified part of the bone, although it takes no part in the mechanical, the resisting and supporting function of the skeleton, is an essential constituent of bone as a living, growing, and self-nourishing part of the body. Could we destroy all this intricate mesh of cells and fibres the bone would be dead in a few minutes. Could we remove all the other, all the hard part without damaging this network, the bone would soon be reconstituted. Nor can I conceive that one little portion of the system—that, namely, which lines the Haversian canals, could be inflamed without extension of the action to other parts, those within the canaliculi and the lacunæ included.

Fig. 24.—Section of the femur of a rabbit—normal—magnified 500 diameters.

It is true that the microscopical verification of inflammatory acts within these minute channels and rifts is much more difficult than in the larger canals ; and herein lies, I think, the second cause of Billroth's too exclusive reading of the subject. His method appears to be only one, viz., dissolving out the lime-salts of the bone to be examined, a method which entirely obscures, indeed generally destroys, the appearance of lacunæ and canaliculi, as well as certain peculiarities in the substance itself. All histologists have acknowledged the many difficulties encountered by those who extend their researches into the morbid appearances of osseous tissue. I believe that the truth can only be reached by multiplying for each specimen the modes of observation, both rubbing down the entire tissue, and by making decalcified sections ; even as I have done, first grinding the bone thin and making a careful drawing, and then decalcifying. I hope in another place to give

the result of much laborious study on this subject; but this work, more especially intended to be clinical, hardly affords space for more than the mere gist and outcome of my investigations.

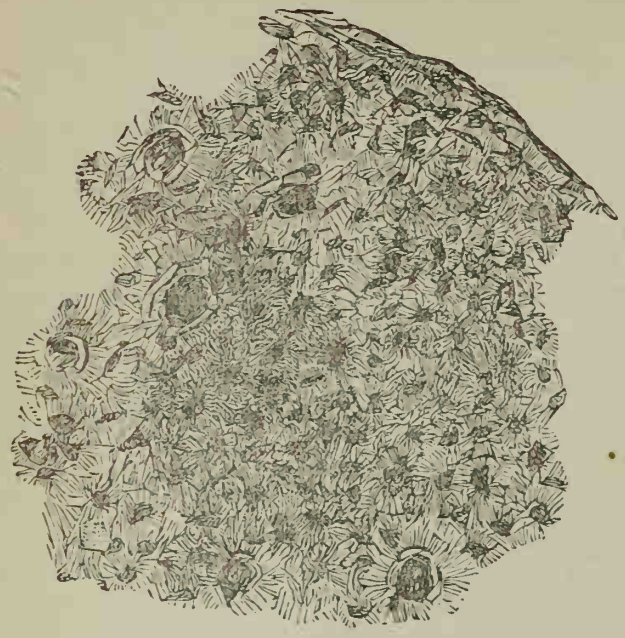

FIG. 25.—Section of femur of a rabbit, close to fracture, magnified 500 diameters. The lacunæ may be seen large and round.

In whatever actions a bone or segment of bone, whether solid or cancellous, is involved, the whole mass, the soft parts and the hard parts, are inseparably conjoined. In the first edition of this work, certain conditions resulting from experimental fracture of the bones of rabbits were depicted which show, as a consequence of the inflammatory condition thus produced, considerable enlargement of the lacunæ (Figs. 24 and 25). I have the preparation still, and the figure is true to nature, but it is very rare to find in the solid bone-tissue of the human subject such uniform and general enlargement. Yet since the above lines were written I have had the opportunity of studying a portion of human femur which is very instructive. The bone is that of a child aged three, who had acute necrosis of the tibia, and suppuration of the knee-joint; the inflammation was spreading up the thigh, which was amputated below the middle. The femur was in an early stage of acute inflammation, it was red but still hard, sections showed the Haversian canals, not at all or very slightly enlarged, stuffed with cells, leucocytes, and granules. The lacunæ were, some of them, of normal size, but most of them enlarged one-half; they were crowded with oil-globules, nuclei, and granules. Other specimens (of which I have a great quantity) taken from bone in the condition depicted in Fig. 23, show in transverse section, at the margin of the enlarged Haversian canal, many of the lacunæ, either not increased or but very slightly so; yet, if the part be carefully cleaned, the contents under a high power will be found to consist of a number of cells and nuclei, or (according to the mode of cleansing adopted) of oil-globules. A longitudinal section shows lacunar enlargement far more clearly; it seems that the pressure of concentric laminæ impedes increase in one direction, but offers less resistance in the other. Again, if a thin plate be taken out of an inflamed cancellar bone, enlarged lacunæ are found filled with the above-described contents, but in this situation more

FIG. 26.—Represents a lamina taken out of the spongy portion at the upper end of a human tibia—normal. The light semicircular portion at the side represents the edge of a cancellus. The longest lacuna is $\frac{1}{900}$ line in length; the largest oval has a long diameter of $\frac{1}{1500}$ line.

especially with oil-globules (Figs. 26 and 27). Very remarkable is a form of strumous ostitis of cancellar bones, very common with children in which the development of fat is enormous; the whole tissue, cells, membranous parts, and even the solid bone, is bathed and soaked in oily matter, and in such cases the rapid softening of tissue is very prominent. From this condition, as well as from the fact that the medulla plays an important part in the absorption and modelling of bone, I would conclude that some fatty and not the lactic acid is the solvent of osseous lime-salts.

Fig. 27.—Represents a lamina taken out of the spongy portion of the upper end of a human tibia in a carious condition. The upper portion of the cut shows a mere pultaceous mass into which the bone has become converted, and in which dark cells from the bone are scattered. In the lacunæ many nucleated cells are frequently to be seen; one, in the lower right corner, is conspicuous for its size and appearance; it measures $\frac{1}{85}$ line in diameter.

As for the appearance of the solid tissue itself under the influence of rarefying ostitis, I can only say, that sometimes it is granular or granulated, that is, marked out by slightly deeper gray coloration, surrounding clearer spaces, into an appearance I can only describe by imagining the scaly side of a fish greatly diminished. Sometimes this darker coloration occurs in wavy striæ—sometimes the whole has an almost uniform yellowish tinge, is more opaque (if examined in fluid) than normal, with here and there a blotch of gray, finely granular consistence. As far as my investigations have as yet gone, I should say that the first described appearance corresponds to a slow, gradual softening—the striæ, which usually run longitudinally, *i.e.*, in a line with the Haversian canals, denote a more rapid action, while the yellowish discoloration appears to occur in specimens that have been on the verge of necrosis.

Recapitulation.—An immense space of investigation and of controversy has been gone over in the last few pages, and lest I should leave the matter more obscure than I should wish to do, I propose to condense in a few sentences the real histology of ostitis.

The periosteum and endosteum of bone are in communication with each other through the intervention of a fine web, consisting of cells and fibres, which permeate the whole space between these membranes, after the manner of the yellow areolar tissue. In this web vessels ramify in intervals much wider than the meshwork of the web itself. This web consists of Haversian lining membrane, lacunar cells, and canalicular fibres. The interspaces are filled up by an intercellular material, partly cartilage, partly lime-salts. When a district of bone inflames, the areolar elements are the active agents, and proliferation takes place in all cells throughout the district, whether these cells are placed in the Haversian, cancellar,

Fig. 28.—Upper surface of tibia, caries from ostitis.

or lacunar lining, in the periosteum or endosteum. The proliferation is easiest to demonstrate in the largest spaces, *i.e.*, in the outer or inner membrane most easy ; in the Haversian lining less so ; in the lacunar portions very difficult. On account of this proliferation, much of the previously normal cellular elements are converted into granulation-tissue, assimilating, or, in other words, converting into their own substance the intercellular parts of the structure, *i.e.*, their chondrin. The lime of those parts falls away, partly in mere detritus (holding no chondrin at all), but is also partly dissolved and carried into the venous circulation. The solvent of the lime-salts is in all probability one of the fatty acids. In the case of cancellar bone, the parts which are played by the membrane lining the Haversian canals and by the endosteum is assumed and carried out by the membrane lining the cancelli. Hence, as such membranous parts and the vessels are much more abundant, so do we find all actions more rapid and widespread ; a bone at such parts is not unfrequently eaten into pits and hollows, deeply and profoundly excavated. Contrast Fig. 27 with Fig. 23, ostitis of solid bone, and with Fig. 28, which is the sort of caries found on cancellar bone-ends.

Osteo-sclerosis, a somewhat different form of inflammation, is, as the name implies, characterized not by softening or rarefaction of the bone ; but by increased hardness and density of the tissue. Ostitis arising from certain constitutional cachexiæ tend more especially to condensation ; such are the rheumatic, certain forms of syphilitic, and, in some phases of the disease, arthritic inflammation. Induration also generally surrounds portions of bone which are undergoing the softening form of inflammation (unless it be of the more diffuse form), and indeed often precedes this condition ; or, when the disease changes and tends to resolution, follows it andf orms the second step in the process of repair. Up to a certain point, then, the histological processes, though slower in the condensing variety, are the same in both forms of inflammation. The same, that is to say, up to the time when granulation has formed, when in a district of solid bone, the Haversian canals have been enlarged, but are still smooth-walled, are not hollowed into Howship's lacunæ, and solution of lime-salts has not begun.

And now the newly-formed material, instead of going through retrograde processes, commences formative action, changing into one of the many sorts of fibrous tissue,[1] which subsequently becomes ossified certainly on the Haversian walls, and probably too on those of the lacunæ. On this latter point I will not speak positively, as the investigation is very difficult. But I may point out as certain that in all indurated parts of bone the canaliculi are more strongly marked than in the normal tissue, and that they appear more crowded and more numerous. This arises not from the formation of fresh channels, but from increase in refraction of the bony tissue in consequence of the additional lime-salts deposited interstitially giving to the light-beam a more acute angle. To the naked eye, bone thus affected shows a greater whiteness and opacity, as also greater hardness and greater weight. Under the microscope the Haversian canals appear smaller, the lacunæ and canaliculi more clear and distinct—in some specimens the substance itself is marked by delicate lines, as of large granules or as the delimitation of crystals ; it is moreover very opaque and difficult to manage ; sections when becoming thin enough are apt to fall to pieces, into mere detritus.

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[1] For the differences between formative and destructive termination to granulation, see Chapter V., p. 97.

The induration of cancellar portions, which very seldom amounts to more than consolidation, is much more easily understood ; it is simply the same process, which takes place when any new layer of bone is formed from either periosteum or endosteum, only the deposition goes on from every subdivision of membrane and upon every cancellar wall, until each cavity is either quite obliterated or until only space enough is left for its vessel. In either place, whether in solid or cancellar bone, the destructive act, ending in softening caries, etc., is the result of an irritation larger than power ;—the indurating act the effect of a less irritation or of greater power. Hence, in cancellar bone the focus of irritation, be it a merely softening portion or an abscess, is surrounded by a hardened ring ; some part of this may subsequently soften to allow a passage of pus outward, or if the inflammation (merely a malacia) decline, induration will succeed to the softening in the centre of disease, while in the circumference, the hardened portion will be restored by reabsorption of the newly deposited bone.

The effects of granulating or proliferating cells within the hard portions of bone-tissue are thus seen to vary with the more or less sthenic form of inflammation, that is to say with the further development of the granulation itself. At present we have but considered the indurating and the softening process, but there are still other conditions which modify the fate of the part. Thus, in very cachectic states, large districts of the new cell-growth may fall into fatty degeneration ; and not only itself perish, but cause the death, the necrosis of all the enclosed bone. Again, tubercle may be deposited in the granulations, thus greatly prolonging and extending both the duration and area of disease.[1]

Thus, when in a cancellous bone-end, for example the head of the tibia, inflammation has occurred, one or more of the following events may be expected, resolution, osteo-sclerosis, osteo-malacia, abscess, caries, necrosis (the last three may be combined with tubercle). The proximate effect, if any, upon the joint, will in great measure depend upon the situation of the disease, whether or no it be near or far from the surface, forming part of the articulation, and whether it tend to advance in that or in some other direction.

The condition in early childhood of epiphysal ends or of short bones, produces certain, by no means unimportant, varieties in the course of inflammation. The solid bony nucleus of these parts surrounded by a case of cartilage more or less thick according to age (see p. 5) and the peculiarities of its nutrition, modify morbid actions in various ways. In studying these conditions, although we may without difficulty obtain specimens of advanced disease, yet in the ordinary course of surgical treatment, it is manifestly impossible to procure examples of the primarily affected joint-ends during early malady. I have, therefore, availed myself of the following sources :

A. In one case the femur and in one the tibia, in another the humerus affected with early primary ostitis, the patient having died of some other

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[1] I have often expressed the opinion that there is no such thing as tubercle of bone, and I am by further study confirmed in this view, since I have never seen gray tubercle in osseous tissue proper, although I have several times seen tubercle-like masses, and once true gray tubercle among granulations, but more often still have observed little round lumps of inspissated pus, closely simulating tuberculous deposit. At first sight it may appear mere hair-splitting to say that tubercle is not to be found in bone, but in the osseous granulations ; a little further thought will show that the distinction is essential, since in the one it would be the cause of, in the other the consequence of morbid action.

strumous malady (phthisis, tubercular peritonitis and meningitis respectively), which in the two first cases preceded the joint disease.

B. The other bone of any large joint to which the inflammation had spread from the epiphysis primarily affected, or from a pre-existent synovitis.

C. Bones of the carpus and tarsus commencing to be secondarily affected.

In giving the results of these investigations, I must premise that somewhat different forms of inflammation, especially with regard to diffuseness over the whole or limitation to a part of the epiphysis, present themselves. Secondary affections are either diffuse or only a little more marked on the side next the original malady, while diffuse primary ostitis is always combined or produced by some strongly marked cachexia, more especially by the strumous.

The local conditions commencing with the earlier appearances are as follows:

1. Hyperæmia giving a more or less deep red color to the bony nucleus, throughout or limited to a part (the color of the nucleus while still solid or nearly so, is yellow or but very slightly pink).

2. The same with effusion of serum, sometimes blood-stained, that lies chiefly between the cartilage and bone over a space more or less large. The cartilage at that spot has either become blood-stained, vascular, or both. (If the age of the patient be such that the bony nucleus is already channelled into cancellous-like cavities, the fluid effusion occupies also those in the neighborhood.)

3. Pus or pus and blood-stained serum in the same positions as above described.

4. A peculiar gray discoloration with softening of the bone nucleus; this may occur in a spot near the circumference or near the centre, and may occupy but a small portion, or nearly all of the nucleus.

5. A carious cavity occupying more or less of the nucleus, adjacent to which the cartilage is also ulcerated and fibrous—the cavity contains thick creamy pus—after a time more and more of the cartilage, toward the nearest surface becomes absorbed until an external opening gives exit to the pus among the soft parts.

6. Necrosis of the entire nucleus, which may shell out of the cartilage like a kernel from a nut. In such cases the dead bone is always entirely surrounded by thick creamy pus.[1]

These conditions may be verified by collating the appearances in such specimens as I have named above, and I believe that they are here reduced to their proper order. Accompanying the changes within the epiphyses are certain conditions of the surrounding soft parts all reducible to inflammatory action, viz., very considerable thickening and induration (often called solid œdema) followed by deep suppuration, sometimes confined to the immediate vicinity, in other cases widespread (adjacent and neighboring). As a rule the abscesses thus formed do not communicate with the pus inside the epiphysis until a late period of the disease.

Greatly as I have tried to condense the histology of ostitis, yet its description has greatly exceeded the intended limits, especially as there still remains the subject of our chief interest, the relationship between bone-

[1] I believe, but the matter cannot be proved, that the pus formed rapidly in one part only of the structure and not able quickly to escape, produces the total death of the bone-nucleus by becoming effused between it and the cartilage.

inflammation and joint disease. This is modified by various circumstances, the most important being the stage of development of the bone itself—for the entire independence, nutritive and otherwise, of an ununited epiphysis, as also the more or less maturity of the bony nucleus modifies the form and progress of disease. The part of the bone affected, whether, namely, the inflamed spot be near the joint, near the external surface, or near the epiphysal line, makes a great difference in the form and prognosis of the malady. In case the inflammation be near the epiphysal junction, the in- or exclusion thereof, from the joint-cavity, is a very important factor in the subsequent events. The species of inflammation has also a marked effect in determining the result. Those inflammations, as are rare in infantile life, which do not tend to suppuration, are less injurious at an epiphysis than those of pus-producing quality, such as struma or syphilis. Traumatism takes a place with one or the other, according to its severity and according to the patient's constitution, whether, namely, it be sthenic, or cachectic and strumous. It will, of course, be remembered, that many strumous inflammations are in the first instance lit up by an injury.

The frequency of strumous epiphysitis in the young subject is to be accounted for in part by the greater prevalence of all manifestations of this cachexia in the young; also, and in larger part, by the hyperæmia and hyperplasia (a necessity of growth in stature) which occupy the epiphysal bone-ends and supply that increment of slight irritation, responded to by prolonged inflammation, on which Billroth bases his definition of struma. In the infant, while the bony nucleus only partially fills the joint-end, certain peculiarities, already particularly described, obtain. In the rather older subject the proximity to, or distance from the articular surface of the inflamed spot, influences not merely the rapidity, but also the mode of joint implication.

If the inflamed or suppurating point lie nearer to the external than to the articular surface, the bone-end attains a considerable size, even periosteal abscess may form while joint-affection (synovial fulness and thickening) is as yet hardly demonstrable. Such cases afford the easiest groundwork of diagnosis, the bone-inflammation spreads by way of the periosteum very gradually; the symptoms of fungating synovitis, *i.e.*, gradual soft thickening of the synovial membrane, are not preceded by fluid effusion into the cavity.

An inflammation, situated near the articular surface, or spreading toward it from the central parts of the epiphysis, implicates the joint sooner and in a peculiar manner; for when the malady reaches the sub-articular cancelli, the cartilage and subjacent lamella become detached in spots; or if the disease be extensive on a large part of its surface (see Fig. 47) a breach either by laceration or necrosis occurs, inflammatory products distil into the joint, and a synovitis commencing with fluid effusion results—synovial thickening then subsequently arises.

Should the inflammation be close to the epiphysal line, and track along it outward, the joint may escape, or more probably will be slowly implicated, after the first method if the junction-line lie outside the synovial sac; but if the epiphysal line be included within that membrane, the articulation will become involved, probably severely after the second method. (See Hip Disease.)

Infantile epiphysitis has been described, and different appearances according to the phase of the disease indicated. The earlier two are, judging chiefly from symptoms, not uncommon, and often get well with no or but very slight involvement of the joint; the last four are exceedingly grave.

Pus formed within an ossifying cartilage will make exit somewhere, and if toward the joint severe disease will arise. The malady is sometimes simply acute suppuration—if the synovial membrane have been previously healthy or nearly so—if that structure have been previously granulating it has become less sensitive, the contact of pus produces a subacute disease; or, if the joint be already inflamed by continuity, the eruption of pus hardly aggravates the condition.

After death or amputation various states are found, according to the sort of primary disease indicated at p. 223. They are these: a nuclear abscess opening into the joint.[1] Abscess on the epiphysal line opening into the joint (acute joint disease), or away from the joint (chronic disease). Almost entire disappearance of epiphysal end (this corresponds to 5 and 6 of my description), the bare diaphysis lying rough, and carious in a large articular abscess. Shrivelling and puckering of the epiphysal end with small pulverulent nucleus; generally a joint-abscess opening in one or in several directions.

In both the infantile and the later form of ostitis peri-articular and adjacent abscesses are common: the latter, more especially when the primary malady is caries, has a great tendency to steal along the bone, sometimes even to a great distance from the joint. Again, long intra-osseous abscesses are by no means uncommon. They are discovered during excisions, and represent on the sawn surface a mere circlet of softening, which on further investigation is found to be the section across a more or less narrow sinus, running up or down the bone beyond the epiphysal line into the shaft, even into the medullary cavity. The other end of the sinus that in the epiphysis itself usually ends in a larger abscess, which may or not, by destruction of cartilage, communicate with the joint-cavity. In such cases it is evident that an epiphysal abscess, beginning probably about the nucleus, passed in two directions to and from the articulation.[2]

Symptoms.—We have seen that strumous inflammation of the joint-end of a long bone is rare in the adult, and common in the young subject. Hence, when a grown person is found affected with ostitis in such a part, it is generally traceable to some other cause—rheumatism, syphilis, or injury. Yet it occasionally happens that such disease does occur in grown persons; but then it is more rapid, and ends rather in necrosis than in caries, and is almost confined to the head of the tibia; though it does occasionally attack the femoral condyles. A scrofulous inflammation of bone is among adults more common in the short, irregular, spongy bones of the carpus or tarsus, but in children nothing is more common than inflammation of the epiphysal ends of the bones.

The first sign of an ostitis commencing as a chronic disease is a dull aching pain in the part, generally increasing at night. When it occurs at so early an age that the patient is not able to give an account of his sufferings, the nurse or mother will first observe that the child is restless at night and cries when, during washing or dressing, the affected limb is moved. When once attention has been thus directed to the part, it will very soon be found that the child avoids using that limb as much as possible. Such symptoms, when they have for a day or two been sufficiently constant to be undoubted, should never be neglected, but the sufferer should be subjected

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[1] See Cases 59, 60, 61, and Mr. Brown's case in Clinical Society's Transactions, vol. ix., p. 175.

[2] Such a find always causes one to reflect upon the possibility (supposing one had been able to diagnose such abscess) of forestalling implication of the joint.

to skilled examination.[1] The child's nurse or mother will point out to the surgeon which limb or which joint appears to her the one affected, and the movements which cause crying or flinching. He should then examine those movements, joint by joint, so moving different parts of the limb that only one joint is stirred at a time, and thus, by watching the expression of face, he will soon know in which the pain is situated. At this early stage the eye will scarcely be able to detect any difference between the affected limb and its fellow. He should then subject the part to a careful manipulation, and should accurately compare the shape and size of every point of the bones forming the joint with those of the fellow limb: thus no alteration can escape him. The first intimation of change is not so much actual swelling; we have seen that the bone itself very rarely enlarges, or, as has been supposed, becomes distended, as by some internal force. What little swelling there may be affects the periosteum and the fibrous textures immediately around. It is at first but slight; I have seen many cases of early ostitis, in which accurate measurement, by a tightly drawn band, has shown no swelling; but in which examination by the hand could detect a subtle change in form, consisting in greater breadth of all the elevations and less depth of all the natural depressions of the part. It sometimes happens that one particular spot will more markedly project, and here a sense of fluctuation often false, may be detected; such condition is accompanied, if the bone be quite superficial, by increased warmth, generally also by tenderness. Such symptoms, corresponding to the changes described as appertaining to the first or congestive stage of the disease, may last for weeks, even for months, and may then subside, or indeed be altogether subdued.

The next phase, that of true inflammation with tissue-changes, manifests itself somewhat differently in the earlier years of life, when the bone or the epiphysis is in great measure cartilaginous, and in later life when the organ is more fully formed. We will give this latter condition the preference. In this stage the heat of the part will be more marked and the swelling more perceptible; the form of the joint-end of the bone will alter, or, to speak more correctly, the periosteum and the fibrous tissues in its immediate neighborhood will become inflamed and swollen. The tumefaction will concentrate itself more particularly at certain spots, in which the effects of the disease will be most strongly marked; thus the internal condyle of the femur will often project very much and pointedly; the enlargement is not bony, but is, although hard, elastic; swelling is, in fact, produced by effusion or the formation of granulations beneath the periosteum in the same way as nodes are caused, but over a larger surface; the tightness with which the material is bound in between the tough fibrous membrane and the bone producing the hardness. These spots of effusion do not last long, but become dispersed and merged into a general diffused swelling, which goes on increasing until it greatly alters the anatomical forms of the bones, exaggerating the breadth of their processes and filling up their depressions, and yielding in points a sense of obscure fluctuation. This swelling does not spread over all the joint, but is confined to one of the bones that enters into its formation, indeed, often to a particular part of that bone. But, and this point is, though its causality be obscure, well worthy of remark, it often happens in large joints, more especially at the knee, when only one

[1] The reader will remember that in strumous synovitis occurring in children, swelling is frequently observed before any symptoms of pain are perceptible; or that, at least, when attention has been drawn to the part by signs of pain, swelling is at once perceived.

portion of a constituent bone is affected that the corresponding part of the opposing bone becomes involved, while the rest of the primarily affected epiphyses remains normal; for instance, when the inner femoral condyle has been for some time swollen, the internal tuberosity of the tibia enlarges, while still the outer condyle remains of its natural size. This form of osseous swelling is often in deep joints imperceptible to the eye, or, at least, is too subtle to be represented by the engraver, but in superficial joints is quite evident. The subjoined plates, from photographs, show the enlargement of the inner femoral condyle, a frequent seat of ostitis, as also the absence of any other tumefaction, and a disease of the ankle commencing on the astragalus. The form of disease was diagnosed during life, and was verified by anatomical examination. To the touch, the osseous swelling marks itself out strongly from synovial thickening; the former gives a sense of increased size of the bone covered by thin skin, or at most as though covered under the skin by a piece of wash-leather. The latter imparts the idea of concealed or diminished bones muffled by some thick, doughy material, which can by deep pressure be moved over them. Beneath this the prominences and hollows of the bone are found to be unaltered.

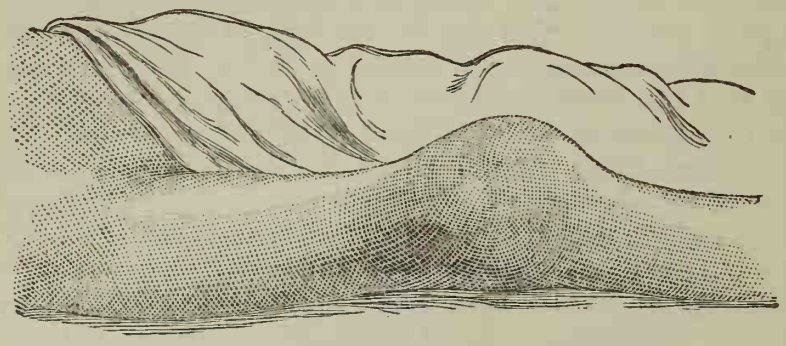

FIG. 29.—Articular ostitis (internal condyle).

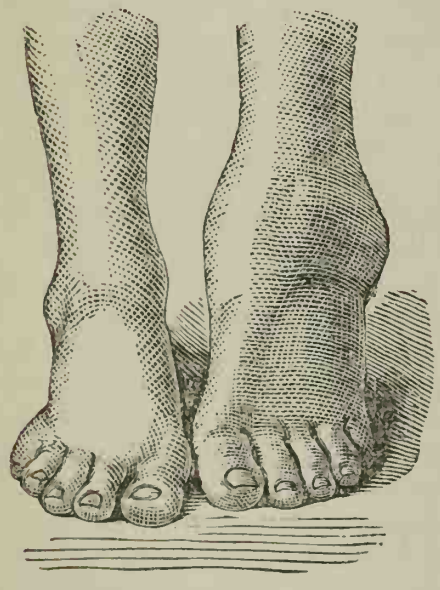

FIG. 30.—Ostitis of astragalus.

At this period it not unfrequently happens that the integuments over the inflamed bone assume, before any joint-malady can be detected, or before it becomes accentuated, a light pink hue. The coloration is at first transitory, coming and going at uncertain periods, and without assignable cause. In some cases a deeper tint will follow and remain more constant. Until the joint is deeply implicated the skin is never abnormally white. This localized redness, more especially if it coincide with projection, tenderness or increased swelling at that particular spot, and if the pain be acute, throbbing, and with irregular intermissions, is usually indicative of osseous abscess. This probability is increased if the tumefaction be over a part of the epiphysal line. At about this stage of the bone-affection, whether or no the synovial tissues have become implicated, contraction of

the flexor muscles may commence. The exact relationship in regard to time of this symptom is variable, depending as it does upon the diffused or circumscribed character of the inflammation, and in the latter case upon its situation near to, or at a distance from, the articular facet. Yet although this retraction may, and often does, show itself before the joint itself is perceptibly involved, it may, should the inflammation be near the epiphysal line, postpone its advent a little further. It always, however, comes on, very frequently accompanied by starting-pains, earlier in the malady of the joint itself than in the pure synovitic disease. Very generally we find, if the patient be old enough to explain his sensations, that these retractions and startings are accompanied by peculiar vague aching along the track of the bone, and not unfrequently in one or other of the nervous trunks, thus closely simulating neuralgia.

These startings are like those observable in the advanced condition of synovitis, when the cartilages are ulcerated nearly through, and the bone-cancelli immediately underlying the joint are injected; but they are more violent, and as the bone is in these cases primarily affected, such spasms commence earlier in regard to the phase of the joint disease. Such violence and early occurrence of these pains are almost enough to mark the malady as an inflammation of the epiphysal end of the bone; and they show, as stated in the first division of this chapter, that the osseous structure just beneath the articular lamella is hyperæmic, and, when very violent, that it is probably suppurating. But the surgeon must be careful in assuring himself that he has really to do with this symptom, for when the disease occurs in young children he may often be misled. The ordinary heavy pain of a commencing ostitis increases, as we know, at night when the patient gets warm in bed, and the generally garbled and exaggerated report of the nurse will lead the surgeon to suppose the child's crying more violent than that dull pain usually produces. If he once stand for a few minutes by the bedside of a patient at night when the *startings* come on, he will not readily forget the sort of movements and restlessness they produce. The patient will probably be found lying in the position which the splint enforces, breathing quietly but rather quickly: suddenly he starts, perhaps half round, perhaps into a sitting posture, with a very sharp, peculiar cry of pain, but almost before he can be asked a question he lies down and goes to sleep again. Dr. Bauer says that, if the patient be awakened, he hardly remembers the attack of pain at all;[1] but this is doubtful, when we know that he remembers it in the morning; and I have found that a child with this disease always cried very much on waking and was frightened, and could only with difficulty be got to sleep again. One could not plainly make out whether he knew of the pain, or whether it merely made part of a frightful dream of which our waking him was the dreadful climax. Older people, from seven upwards, have the very clear idea of the pain; but on watching a boy, aged ten, thus suffering, I found that he did not wake sufficiently to be conscious of external objects, and went to sleep again directly; on questioning him the next day, however, he described exactly the sort of rapid shock of pain which the expression of face and gesture indicated. We shall have occasion to recur to this symptom, as it is most important in its effects as well as in its semeiology.

At this point a tabular view of the differences at this stage between an ostitis and synovitis will probably help the reader to follow the points of diagnosis.

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[1] Bauer on Hip Disease, p. 8.

DIAGNOSIS BETWEEN STRUMOUS ARTICULAR OSTITIS AND STRUMOUS SYNOVITIS IN THE EARLIER STAGES.

Strumous Articular Ostitis.	*Strumous Synovitis.*
The first symptom is heavy, dull pain, with limping or other imperfection in the use of the limb; this comes on before any swelling is perceptible.	The swelling is either before pain, or is discovered with the pain.
The pain is generally increased in bed, and is subject to variations; sometimes quite disappearing for a time, and again returning.	Pain is a later symptom as regards visible swelling, yet when it comes on is constant.
The swelling at first is confined to one bone of the joint, for instance, at the knee, the upper when the femur, the lower when the tibia is affected. Afterward, though the whole joint is enlarged, the tumefaction is more marked, harder and larger over the bone primarily affected, and is nearly always on one side of the joint. The division between the constituent bones remains evident to the touch.	The bones forming the articulation are blended by the swelling into one rounded, shapeless mass, which overlies both parts of the joint equally, and conceals greatly or altogether the line of junction between the two bones. There is no preference of place; the swelling is equable over the whole joint.
In all but the deepest-placed bones the integuments over them are sensibly hotter.	The integuments are not at all, or scarcely, increased in temperature.
Retraction of muscles, often without any starting-pains, is an early symptom.	Retraction of muscles, accompanied or preceded by starting-pains, is a later symptom.

Such is in brief the history of a strumous articular ostitis of the joint-end of a long bone ending in caries or central abscess. Osseous disease is proverbially slow; but this form is of all perhaps the slowest, whose steps are least marked and definite, subject to repeated retrogressions, followed by exacerbations. Its beginning, too, is often so gradual and insidious, that the moment of commencement cannot be fixed; but occasionally a more definite origin in some slight twist or blow will give occasion to a malady whose first steps are more rapid and well-marked. A more severe injury may indeed give rise to an epiphysitis, leading pretty quickly to suppuration, which, if it track toward the joint, occasions malady so acute as to exclude it from the present chapter (see p. 179 et seq.); or the same events may after a time suddenly supervene upon a malady hitherto chronic, if abscess around an epiphysal nucleus open with some rapidity into a joint-cavity (see Chap. X.). It becomes desirable, therefore, whenever it is possible, to diagnose intra-osseous inflammation as early as it is feasible to do so; this will exercise all the acumen which the surgeon can command. The signs of an abscess in a cancellous bone are little else than the symptoms of tension, of which, if the pus have formed slowly, but little may be present. Yet an abscess not of the most chronic sort, marked perhaps by throbbing, by more severe pain, by aching of a sharper character than the dull sensation of a chronic non-suppurative synovitis, is generally present during some part, usually more than one part, of the twenty-four hours. The skin often, too, assumes in one spot a red blush, which may vanish and recur at uncertain intervals. Later, unless the pus-formation have

been very slow indeed, a tender prominence at one or the other part, and usually where the skin has previously shown the red signal, appears.

In the slower forms of disease the synovial membrane becomes very gradually involved by extension of the inflammation from the periosteum to the subsynovial tissue. At first no perceptible increase of secretion takes place into the sac of the joint; but a process of soft thickening commences, which, produced by the same granulating process as in a strumous synovitis, causes a similar condition of the part. The joint, however, does not become rounded and shapeless to the same degree as in the fungoid and pulpy granulation of synovial membrane; on the contrary, the place of origin of the disease maintains its pre-eminence, and is not, till late in the disease, so covered but that its morbid condition is to be detected by deep palpation exercised with some considerable pressure. The sense to the hand is that of an enlarged bone, separated from the skin by a more or less soft and not considerable thickening. In strumous synovitis the shape of the bones is almost or entirely obscured by a thick, soft mass, which so covers them that they can hardly be felt. Throughout the first stage this difference persists.

There is, however, another form of disease which also may be situated in the epiphysal ends of bones, rather more rapid in its course, whose inflammatory action terminates in a necrosis instead of in a caries. Such cases occur, as a rule, to persons of riper years: the first symptoms brought on by accident or exposure to cold are sufficiently sharp to be remarked, and are sometimes very severe; perhaps there will be a shivering fit followed by considerable fever, and very acute pain in the bone. Gradually the feverish symptoms diminish, and even the pain will be less severe; but it recurs with considerable violence at night, and the affected head of the bone swells to a marked extent. The tumefaction is hard, inelastic, bony—is, in fact, bone rapidly formed beneath the periosteum—the swelling is not covered by thickened soft parts; on the contrary, these latter become thinner, and are tightly stretched. The disease (necrosis) is more common in the shafts than in the joint-ends of bone; but, occurring in this latter, it is almost confined to the head of the tibia, olecranon process of the ulna, condyles of the femur and humerus. Being thus situated in parts very superficial, the form, shape, and consistence of the swelling are plainly apparent; the soft parts are, as said above, stretched tightly over it, being more adherent than usual to the subjacent hard tissue. The pain, viz., severe aching, with which the disease began, soon considerably diminishes, and generally starting-pains will come on; but these are mild, and do not form a subject of dread to the patient, or of special complaint, nor do muscular contractions form a prominent part of the disease; nor does the general health suffer to any great extent. During the process of sequestration pain will recur with even greater violence, but with a noteworthy change in character. It is now due to the second, the ulcerative stage, by which the dead portion is separated, and in which, therefore, we should expect to find the symptoms approach more nearly to those of caries. Now, the sequestrum may lie in the middle of the spongy mass, or it may be chiefly situated on some external part; or, again, it may lie close to or include some portion of the articular lamella. These various conditions make a good deal of difference in the prospects and termination of the case; hence, it is extremely important to be able to distinguish a necrosis from a caries of a joint-end, even before an external opening shall have been formed. The points of differential diagnosis may be thus given.

DIAGNOSIS BETWEEN NECROSIS AND CARIES IN THE JOINT-END OF A LONG BONE DURING THE EARLIER STAGES.

Symptoms of Necrosis.	*Symptoms of Caries.*
Disease begins with a smart attack of pain and fever after an accident or exposure.	Disease so insidious in its attack that its actual commencement is difficult to fix.
Swelling equably hard, inelastic, bony; an exaggeration of natural form lies close to integuments, which are adherent and seem thinned.	Swelling less hard and not equably so; fluctuates obscurely in places; the parts between bone and skin puffy, thickened.
The pain with which disease began sharp and severe, but soon diminishes very much; then returns with other character—disease continuing all the time.	The pain begins less severely, but as long as disease lasts goes on increasing up to a certain point.
If starting-pains come on they will not be very severe, and do not form a great subject of complaint.	The starting-pains very severe, and engross the patient's attention from other pains of disease.
Permanent contractions are unusual as accompaniment.	Permanent contractions constantly accompany caries of a joint-end.
The general health does not suffer much.	General health very much injured by disease, sleepless nights, etc.

SECOND STAGE.—It is not a necessary sequence of necrosis, situated in a joint-end, that inflammation of the articulation should follow, because the dead bone may be situated so favorably that its separation can be secured without interference with the joint; but it sometimes happens that a necrosis will include the articular lamella, or that pus, produced in the process of sequestration, destroying a portion of or perforating that structure, will find its way into the joint. If the necrosis have been so rapid that the synovial tissues up to the time of this occurrence are pretty healthy, a suppurative synovitis (more or less violent and acute) complicates the condition; but, if the progress of the bone-malady have been so slow that the joint is already diseased, its cavity perhaps partially filled with pus, no such violent symptoms ensue; the disease is very grave; but it is subacute, sometimes chronic. I know of no symptoms which would clearly indicate, under these latter conditions, the exact period of eruption from the bone-cavities of pus or detritus into the synovial area; nor indeed is it of any importance to distinguish the particular moment of such event. The symptoms above detailed and tabulated mark clearly the species of disease; and, as we have seen, pus does not, unless the abscess be unusually acute, burst suddenly into a previously healthy joint; but first detaches the cartilage, or eats little openings through it, and so distilling slowly into the cavity, produces an equally gradual inflammation, which in large joints may be almost confined to the special part subtending the diseased portion of the bone. I have more than once resected the elbow-joint, as also the knee-joint, in which the inner or the outer side only was filled with granulations, and the cartilages ulcerated. In these cases (necrosis) there is rarely any abscess in the soft parts at a distance from the joint, nor is any one point of the affected bone particularly tender until later in the case, when separation of the sequestrum by a process of caries commences.

Caries implicates the joint even more slowly, but there is usually over

the affected portion of bone a spot generally small and with conical projection, soft and exceedingly tender, which at times becomes red and occasionally fluctuates. After awhile this little spot becomes larger, and fluctuation is permanent: it is a peri-articular abscess opening outward, and nearly always in more or less indirect communication with the seat of caries. Very often, as in the case from which the figure is taken, a certain amount of posterior subluxation is contemporary with the formation of such abscess—partly because the spastic contraction of the flexors is now more potent, partly because the ligaments have become softened.

Abscess among the deep muscles or creeping along the bone, even to a considerable distance, is common. These adjacent abscesses, if well sought for, may be found by tracing the limb downward with the finger-tips of both hands applied at either side. The bone thus compressed presents on one of its aspects a sudden hard ridge, which can hardly escape detection; a similar increase of bulk among the muscles points clearly to intermuscular abscess. The pus is not derived from the carious centre, but is the result of spreading irritation; later on, indeed, the two foci may communicate. A distant abscess late in the disease generally originates in caries,

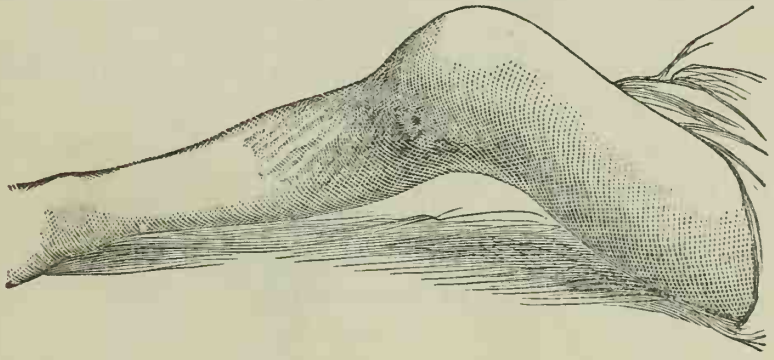

FIG. 30a.—Ostitis of condyles.—Posterior subluxation.

for slowly-formed pus burrows far among tendons and fasciæ, breaking forth usually a long way from the diseased spot. The formation of matter among the soft parts is always accompanied by increase of pain and aggravation of the general symptoms. These are not relieved by opening the abscess; on the contrary, they are rather aggravated. From the wound produced by the bursting of the abscess flows at first flocculent pus, which after a little time becomes thin, watery, and of an irritating character; it blackens silver and contains salts of lime. As the abscess empties, florid granulations crop out of the wound, forming the much-dreaded "proud flesh." In a little time the cavity of the abscess contracts, but only partially, leaving a passage or sinus, which may or may not lead, with many turns and windings, to the diseased bone. The granulations which crown these sinuses are deep red (crimson), and bleed very easily; round the opening for some distance the skin is thin, contracted, and often has a peculiar purple look. The surgeon will naturally pass a probe into the sinus, and endeavor to feel therewith the rough surface of diseased bone, but it is very likely that he will not come at once upon such surface, either because the opening does not communicate with it or because the turns and windings of the sinus, sometimes along a piece of fascia, sometimes round a tendinous sheath, may easily check the passage of a probe; the bluish circumference of a sinus filled with bright florid granulations is a sign so

positive, that the mere fact of not being able at once to reach diseased bone should not be allowed to negative its inference. A little patience and some ingenuity will, on a subsequent visit, find the proper channel; but never for the mere sake of feeling the diseased bone should the probe be thrust violently through opposing structures. The bone is felt to be rough, but generally soft, and the friable cancelli yield a little to gentle pressure with the probe, the superficial portions breaking away.

DIAGNOSIS BETWEEN NECROSIS AND CARIES IN THE JOINT-END OF A LONG BONE DURING THE LATER STAGES.

Symptoms of Necrosis.	*Symptoms of Caries.*
When pus forms in the soft parts, and more particularly when it has been let out, the symptoms diminish.	During formation of pus the general and local symptoms increase in intensity, and continue to increase even after an external opening has been made.
The sinuses are crowned by florid, but not brilliant, granulations, which do not bleed with extreme ease. They are surrounded by normal or slightly altered skin.	The sinuses are crowned by florid brilliant crimson granulations, which bleed extremely easily. They are surrounded by thin blue contracted skin.
The pus is not large in quantity, and is in general nearly laudable.	The pus is plentiful, thin, and irritating.
A probe passed along a sinus to necrotic bone finds the passage tolerably straight and simple. The bone is hard, brittle, sometimes movable. Often one may feel the probe pass through a sinuous opening (cloaca) in bone before it comes to the dead portion.	A probe finds the diseased bone-surface with difficulty on account of the windings of the sinus. The surface is rough, slightly yielding, not brittle, though parts give way—it gives an idea of mortar-like softness.

There is a low form of inflammation of bone, which affects more often the cancellous than the harder parts, termed *caries necrotica*, which, as that name implies, is a mixture of both processes, comparable to phagedænic ulceration of soft parts; and as in those parts, either the sloughing or the ulceration may be the dominant action: in Fig. 28 is shown such condition at the upper end of the tibia, ulceration being the chief but by no means the whole malady. The necrotic condition may, after weeks or even months of caries, supervene upon the previously slow disease, and almost suddenly usher in great ravages; perhaps acute and violent suppuration of the joint, with danger to both limb and life. Or the bone disease lying nearer to the epiphysal line may, while setting up less trouble in the joint itself, produce diastasis with singular deformity.[1] The following engraving is from a youth whose tibia, chiefly on the inner side, was affected with necrotic caries; separation of the epiphysis had occurred. The disease had to a certain extent passed to the inner condyle of the femur. The joint outside the crucial ligaments (which formed a kind of septum), although very soft and to a great extent converted into granulation-tissue, was comparatively little affected.

We will now turn for a time to certain forms of articular, or as it may here be termed, epiphysal ostitis, peculiar to early childhood; since certain symptomatic peculiarities only appertain to that period of life during which

[1] The same result may arise from synovitis, see p. 108.

the bone end is, save for an osseous nucleus, entirely cartilaginous. The parts which most frequently thus inflame, are the head of the femur—the tarsal bones—the femoral condyles—the head of the tibia—the bones about the elbow (most commonly the ulna, least so the radius) the epiphysal ends of the metacarpal bones. The disease manifests itself by hard, deep swelling—which surgically would be called bony enlargement, did we not know that the part in question is still almost entirely cartilaginous. At first this swelling, with or without considerable restriction of movement, more especially in the direction of extension—perhaps even fixed flexion of the limb and considerable pain on movement, is all that can be detected. The infant hates and resents any handling of the limb; but while at rest seems

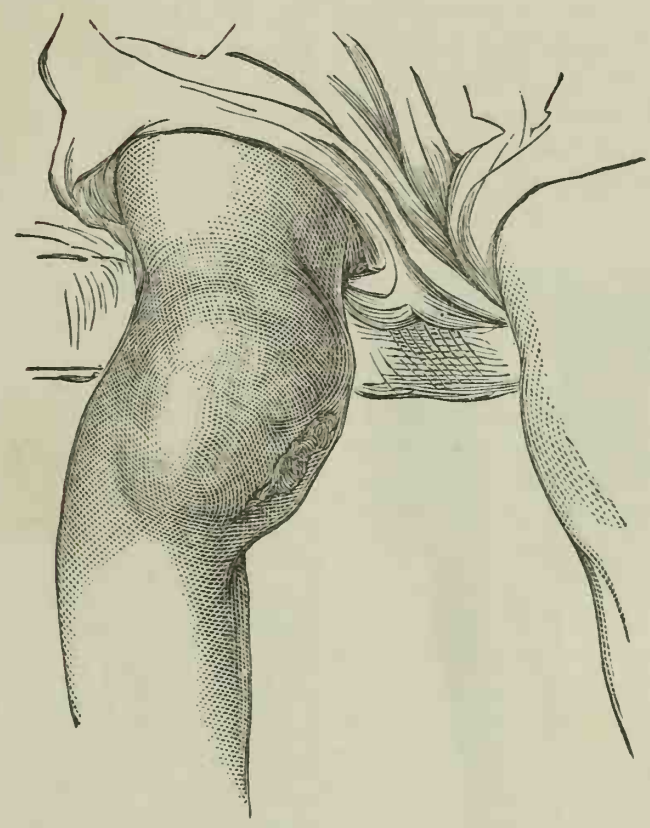

FIG. 31.—Caries necrotica of tibia (diastasis).

comfortable. Such phase may be very transitory or may last for several weeks. Then, but by no means in the majority of cases, an acute suppuration of the joint, with great pyrexia, pain, exhaustion, and swelling, occasionally ending in rapid death, may follow. Such symptoms mark the rapid irruption of pus from an epiphysal abscess into the joint. The disease is most common [1] in the first year or two of life; but is not, as some instances under my own care show, confined to that period. At the hip, for instance, it may occur much later.

If no acute symptoms supervene, the swelling and the restricted movement above described may go on for months, exceeding even the limits of the year. In certain cases, and these differences depend on the proximity of the inflammation to the joint-surface, very little change takes place, save increase of swelling and gradual extension of disease to the synovial mem-

[1] See Mr. Smith's cases in St. Bartholomew's Hospital Reports, vol. x., p. 189.

brane ; in other cases marked flexion and wasting of the limb, with nightly fits of crying, while still the synovial tissues are but slightly implicated, are the chief symptoms ; while, in still a third class, peri-articular and adjacent abscess form early. If these open near the joint, the wound is particularly apt to enlarge into a rather wide, ragged ulcer, the skin surrounding which is often somewhat widely undermined, a condition, be it remarked, very different to the small sinus-like opening, that accompanies the ostitic abscess of later years, and which probably results from the slow production of the pus. Another peculiarity of this early stage is the extreme slowness with which the joint becomes involved (save under certain conditions already and again to be mentioned), a slowness not merely of time but of events. I have seen the femoral condyles, the olecranon portion of the ulna, the distal end of the metacarpal bone of the thumb and of the great toe very greatly enlarged, while the respective synovial membranes have been free, or very nearly free, of swelling or inflammation.

At any point, even after the formation of adjacent abscess, the symptoms may retrogress—an event which is more common if the disease be about the hand or foot than in the neighborhood of a large joint. The method and order of recession is this : first, the pain and tenderness decrease and disappear ; then the discharge (if any abscess opening have existed) gradually diminishes, the surrounding reddened skin contracts, and is drawn inward, and the wound heals. I question, however, if the cartilaginous swelling declines to any appreciable extent. A certain diminution of size about the part may be verified by measurement ; but it is very slight, so slight that it may be entirely due to decrease in the swelling and engorgement of soft parts. I have for years watched children who have recovered from this form of inflammation, and have found the limb remain larger than the other, until growth has rendered the proportion of difference less conspicuous—whether that difference be merely in circumference or also in length of limb.

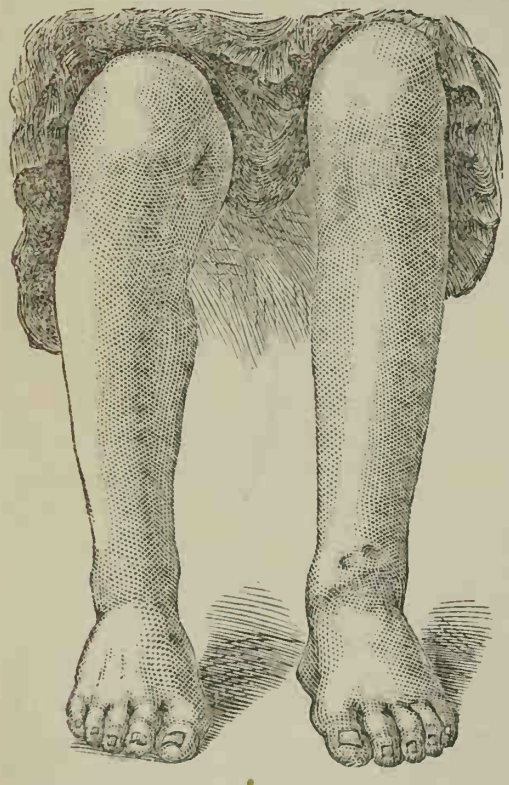

Fig. 32.—Ostitis of tibial tuberosity, with shortening.

On the other hand, the nuclear ostitis may not recede, but go on to suppuration ; and now even more than in the ostitis of mature or advanced life the fate of the joint will depend upon the direction which the pus may take ; and this again depends upon the side or aspect of the osseous nucleus which was originally affected. If the pus pass outward away from the joint-surface—as, for instance, happens occasionally at the knee just above the attachment of the lateral ligaments, or at the tibia on the inner side of the tuberosity, the articulation is not of necessity much involved—the abscess has passed along the epiphysal line. In these cases growth of the bone is for a time entirely stopped ; it nearly always is resumed, but only after some months, and a permanent shortening very frequently remains. This

is often obscured by flexion, or some other malposition, and is less often detected than it would be if the limb were straight or capable of being straightened.

I have verified in several instances—indeed, in all my cases of ostitis which have been followed by increased or decreased length of the bone— a condition due to changes at the junction between diaphysis and epiphysis.

In giving the above account of symptoms, I have more particularly limited the description to disease as it occurs in the larger articulations, and indeed have had maladies of the knee more particularly before my eyes. Although the morbid history is identical for all large joints, it is in those which are formed by smaller bones somewhat modified ; particularly if a number of such joints be included in one synovial membrane, and more especially if they be very much surrounded by the dense tissue, which forms tendons and their sheaths. All these peculiarities of structure and surroundings belong to the carpal and tarsal joints. When strumous affection attacks such parts, the whole neighborhood is involved in brawny, hard tumefaction, which conceals the normally not very perceptible points of bone, and renders in most cases diagnosis, as to the exact locality whence disease originated, very difficult or impossible. If synovitis pure and simple ever attack these parts, the wide distribution of the membrane among the ossicles prevents limitation to any one spot. If the disease originate in a bone, the same anatomical arrangement diffuses inflammatory conditions to a considerable distance. As a matter of fact, primary ostitis, both at the wrist and foot, is very much more frequent than primary synovitis ; and yet at the carpus, until abscess and sinus form, it will generally be impossible to distinguish more closely, than that the malady is at the inner or at the outer side of the limb ; while it is more often possible to recognize among the larger constituents of the tarsus which particular bone is involved. Abscess at the wrist may not—indeed generally does not—point close to the spot affected, while at the foot redness and tendency to the surface are frequently in the immediate vicinity of the disease ; yet sometimes at a distance. Even when an opening allows the passage of a probe down to diseased osseous tissue, considerable acumen may be required to ascertain which of the bones has been touched. It is wise not to be content, when disease has been found in one part, with a diagnosis that the malady is in that place alone ; every channel of the sinus track should be tested by very tender manipulation with the probe. Not unfrequently a single sinus mouth is the opening to various passages, each one perhaps leading to a different bone. I may say here, though it hardly belongs to this part of the subject, that even after the most careful examination, made with the best skill, an operator will often prudently make his first incisions so as to leave him the choice of terminating his operation in one of several ways.

We will return to the malady as it affects the larger joints. The phase now reached is that in which abscesses have broken or been opened in one or more places, near to or far from the articulation—through these openings diseased bone may be detected ; the synovial tissues are granulating ; the joint-cavity, what remains of it, contains pus. Even at this stage the disease may recede, in this wise : the sequestrum, if there be any, separates and comes or is taken away ; the carious surfaces cicatrize, the discharge diminishes, the sinus mouths retract their granulations, and even the skin around them puckers inward, the synovial swelling slowly disappears, and then with some amount of false or true anchylosis, perhaps with angular deformity, the joint heals. The resultant anchylosis, unless carefully treated by passive movement, is usually though not always a true one. As in stru-

mous synovitis, retraction of the granulated tissues draws the skin close to the bone and produces depression of the healed sinus mouths; but in these cases, moreover, the bone primarily diseased is generally left smaller than the sound one, both in circumference and in length. The annexed plate, from a boy aged eleven, who suffered in early childhood from ostitic joint disease, illustrates well these various points. He had a false anchylosis at a right angle, with slight subluxation, the sinus mouths were depressed, the tibia, measured from side to side with callipers, was nearly half an inch narrower than the sound one, and was just over an inch shorter. The femoral condyles were very slightly narrower, but absence of pressure in the normal direction had permitted their elongation. There was no shortening of the thigh.

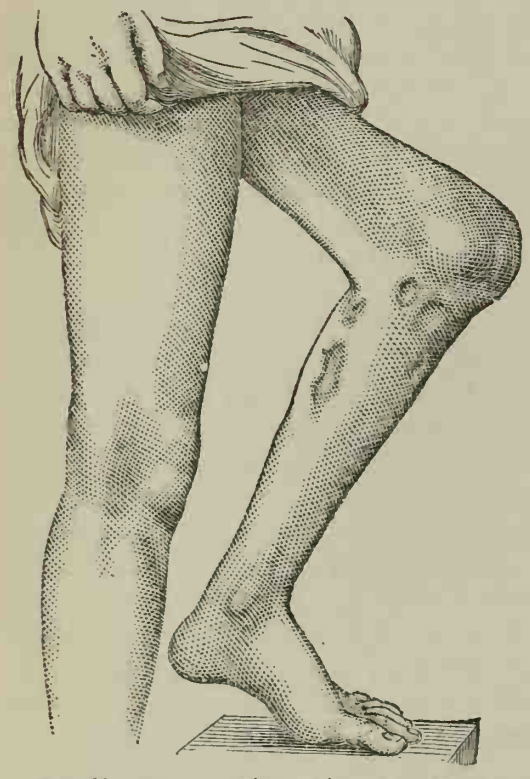

FIG. 33.—Recovery after ostitis of tibia. Angular false anchylosis.

It must, however, be observed that occasionally a somewhat different condition pertains, in that the diseased bone remains permanently larger than the norm; this appears to occur when a considerable amount of the tissue has sclerosed rather than softened.

Accompanying, indeed sometimes preceding, this local improvement, considerable amelioration in the general health occurs, better coloration, softer and smoother condition of skin, cessation of irregular sweating, less suffering expression of countenance, and less pyrexia. The thermometer is not only lower, but the temperature line is no longer so precipitously serrated; it is more even and regular in its smaller gyrations.

Treatment.—The preceding pages having shown, I think conclusively, that ostitic joint-malady not only can be, but, if we are to know and treat disease scientifically, must be, distinguished from synovial affections, it becomes the duty of the present section to show how our knowledge may be utilized.

General Treatment.—It may be asked if any internal remedies can beneficially affect an inflammation localized, like the one we have been considering, to one little spot of the body. I can only answer by suggesting a side issue. If it be a cachexia which is keeping up the irritation, the question must shift its ground. Can we benefit a constitutional condition? Let me, as Sir B. Brodie was fond of doing, point to morbid states of the eye. Few affections can be more localized than strumous conjunctivitis, with its photophobia; it may go on for weeks in spite of blistering or drops into the eye, etc., yet a brisk purgation, usually with a little calomel, will sometimes clear it away in twenty-four hours. The form of struma with thick connective tissues is liable to peculiar formation of viscid mucus in the intestines, which prevents due nutrition and keeps up irritation. So again, when phlyctenulæ have left small ulcers on the cornea, which are as local as any disease can be, some general remedies often prevail.

Thus, a child with an enlarged and tender joint-end, but as yet with no

joint disease, may be treated, if he have the thick unwieldy form of struma, with one or two purges of calomel, or gray powder and jalap, followed, if there be ascarides, by an iron and quassia injection. After this, if the child be large and strong, some such formula as two grains of gray powder, with one of quinine, night and morning, for three or four days; after that the quinine may be continued alone or iron may be substituted. Iodine also is especially useful.

If epiphysal disease occur in a child, having the thin, clear, finely modelled struma, the malady tends to run through the first stages with greater rapidity than in the other variety. I think that hardly anything can be added to what has already been said (p. 120) concerning the general treatment of such condition.

Local Treatment.—Rest, even in the early stage, must be enforced by means of a splint, as already sufficiently described; but this need not be so absolute and complete as is necessary in synovitis; the question of irremovable apparatus does not come before us until the joint itself is diseased.

Ice, indeed any really cold applications, are injurious; they increase deep hyperæmia. Heat, best applied by salt-bags, not only affords relief, but is, in my experience, frequently beneficial, especially if used early, in cases due to some traumatism. This acts, I believe, by drawing the blood-supply toward the surface, therefore away from the bone, more especially from the deeper parts of that structure.

The effect of blisters, or other revulsives, is, I presume, very similar; their action may be carried somewhat farther than in synovitis, but not beyond the commencement of vesication. Any bared surface should be allowed to heal at once, hence the blister should not be large, so that frequent repetition shall be feasible.

A small line drawn with the actual cautery has, in my hands, often proved advantageous, and is more especially adapted to this form of disease, but to be useful, it must be applied before abscess has formed. The most convenient mode of application is by Petrequin's *thermo-cautère*, heated by the india-rubber pump to a white heat. The actual edge of the knife should be avoided by holding the weapon a little obliquely (sideways). The glowing platinum is then to be drawn rather slowly, with pressure of a few ounces along a line, each side of which is protected by two or three layers of thick, wetted plaster. As soon as the mark is made, and while the patient is still insensible, the plaster is gently taken off from the outer edge *toward the burn*, lest one remove with it an unnecessary amount of cuticle; the place may then be thickly covered with flour or finely-powdered oxide of zinc, lint and bandage. The effect of this treatment in properly selected cases is to give immediate ease from the dull aching pain—startings, if there have been any, cease, and the burn gives no pain at all if the metal have been hot enough. Of course, in a certain number of cases, the sufferings due to the ostitis return (generally mitigated), but this is owing either to an error in selection or to inveteracy of disease. Again, I have known, even after a modified return, that the symptoms and the disease have slowly and gradually disappeared.

Nevertheless, I would not wish to overpraise this treatment; its application requires considerable judgment;[1] it is most useful when the malady

[1] In my first edition I spoke of the actual cautery more especially in reference to strumous synovitis; herein I, misled by its marked effect on starting-pains, made a mistake: it acts upon the bone-hyperæmia, causing those pains, hence is useful in ostitis, whereas I looked on the relief of these bone-symptoms as a sign of its value in the synovial disease.

is not markedly localized to one spot of the bone, and when there is reason to believe that no suppuration has occurred. It is more likely to be beneficial in the slower than in the more rapid forms of disease, and when pain, almost absent in the day, comes on without throbbing, but with starting at night.

Whether or no the *ferrum candens* be used, extension should be employed to the joints of the lower limb certainly, while to those of the upper it is of less importance ; chiefly, I suppose, because the muscles are less strong. The subject of extension must be considered with that of open air, of movement, or of quietude. A question in most cases most difficult to decide is that of rest or exercise, and it is one which permits of no general reply ; each case must be answered on its own merits. For instance, if the disease be in the upper limb, a splint should certainly be employed, but the child should be allowed to walk, even to run about ; also if it be in the lower limb—be of the chronic description, and do not as yet involve the joint, the expediency of keeping the child in bed is very doubtful. Certainly no weight must be supported by the limb ; but exercise may be given by driving in an open vehicle, a swing out-of-doors, a tricycle worked by the hands, and in some cases by Thomas's arrangement of high-shoe and crutches, with or without one of his splints, according to the amount of joint-implication. I feel so assured of the ill-effects on infantile ostitis of confinement to bed and to the atmosphere of a sick-room, that I use any feasible expedient within my patient's reach to avoid it, from the homely perambulator to a couch in the square garden, a mattress on the beach, or an open landau. Even when considerable joint-affection is present, I, taking precautions against movement and displacement, still insist upon as much air as the place and season may afford, and as much exercise as can be procured without chance of moving or injuring the articulation.

Whatever means are employed for this purpose, some form of extension should be used, at least during the night, and in any of the severer phases also during the daytime. American surgeons employ certain appliances for making extension from strapping-plaster.[1] I will describe that for the knee, although I have failed, with great regret, to find it valuable, since all the plasters I have ever employed glide on the shin, and extension ceases in a few hours to be exercised. The instrument consists of two hoops, one for the thigh, one for the leg, connected at each side by rods capable of being lengthened by ratchet movement. The thigh is surrounded by plaster-strips, placed lengthwise, and the same is done for the leg, the knee being excluded. Both segments are bandaged, leaving uncovered five inches of the plaster at the top of the thigh, and at the lower part of the leg. Now the instrument is placed *in situ*, the ends of strapping turned over the hoop, and secured by the roller. When all is adapted, the ratchet movement is said by Dr. Sayre to make sufficient extension to allow a child, apparently about eight years old, to walk without pressing the femoral and tibial surfaces together. In effecting this I have not succeeded, as also I have been unable to devise any instrument which shall enable a patient to walk on the foot without throwing weight on the joints of his limb, unless such appliance runs the whole length of the extremity and gets its bearing at the perineum. Moreover, if the joint be sufficiently diseased to require permanent extension, the wisdom of permitting active locomotion is doubtful. The risk that the instrument may fail at some critical moment is considerable, or the patient may, through some

[1] Sayre's Orthopædic Surgery, p. 203.

mishap of his own or of the appliance, fall, or merely stumble, saving himself by a wrench that may cost him his limb.

The patient's leg and thigh may be secured in dextrine, water-glass, etc.; and at night, either from strapping or the special stocking, weight-extension can be made. This is the simplest means, and often quite efficacious and sufficient. But if the patient is to go out in the garden, or to drive, this cannot be managed unless the whole bed and apparatus be carried with him; nor can weight-extension be used while he is lying on the ground. For such reasons an extension splint (Fig. 34) may be advantageouly employed.[1]

The principle of its construction is to make a strong india-rubber spring, or accumulator, act as both extending and counter-extending force. For this purpose it is fastened by each end to a piece of catgut that plays round pulleys, attached to either end of the splint. I will describe particularly the arrangement for the knee.

A Desault's splint, reaching from the middle of the trunk to two inches below the foot, is furnished at its upper part with a loop of strong wire or of steel (A), which carries a small pulley, and which projects outward about an inch and a half. The lower part is provided with a bar, running across the space of the notch, and also carrying a pulley (D). From the lower end of the splint, projecting inward an inch or an inch and a half, is another loop, carrying a third pulley (E). A perinæal band (B), passing round the upper part of the limb and splint, has a piece of rather thin catgut (violin string *A* or *D*) attached to it, which going through the upper loop of wire runs round the pulley (A), is brought down on the outside of the splint, and is attached to one end of the india-rubber accumulator (C). Another piece of catgut is attached to the appliance on the leg and foot; it passes under the pulleys E and D, and is attached to the other end of the accumulator, stretching the india-rubber sufficiently to make what downward traction may be necessary. This splint holds to the limb by its own elastic force, and may be so used outside a starch or dextrine bandage. If it be employed as the sole appliance, it should be made rather narrow, and the limb is to be secured to it by one of the irremovable bandages; or a similar contrivance is so easily adaptable to a back splint in the gutter form, that I need not describe the method here.

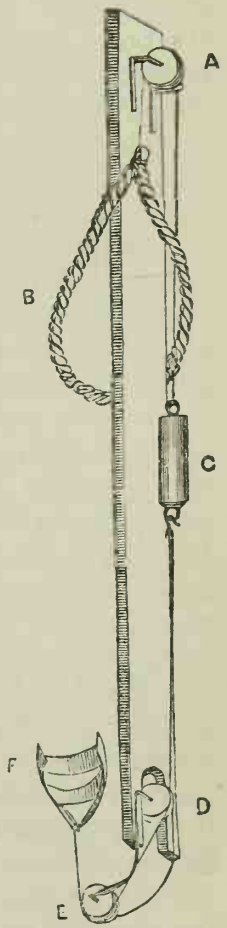

FIG. 34.

If the signs of a distinctly localized ostitis be present, and *à fortiori*, if they be combined with those of intra-osseous abscess, the surgeon will consider whether he will be wise to let the pus take its own course to the epiphysal line—perhaps loosening the junction—or, still worse, into the joint; or, on the contrary, whether his hand ought to be the guide, which shall lead the pent-up matter to a harmless exit. His conclusion must be based on several considerations; 1. Are the signs so distinctive that he may feel sufficiently assured of finding the abscess? 2. Suppose he do not find it, will his procedure result in injury? 3. Is the place of redness or prominence, or both, so situated that he can reach it without damage to the synovial membrane?

[1] A modification of this method is also used by Dr. Sayre for the ankle.

The first consideration requires two answers, according to the age of the patient. In very early life, while the bony centre is still small, the painful or swollen spot is sure to be on the same side of the nucleus as the malady, and it is barely possible—given a sufficient knowledge of baby-anatomy—to miss this spot. If the patient be full grown, or nearly full grown, it is indeed possible to miss the abscess;[1] yet these are generally not very far from the surface, and some further examination, soon to be described, may assist in detecting the locality of disease.

The second consideration—the possibility of doing harm from failing to find abscess, need not seriously affect our practice. No surgeon would of course undertake such a measure unless the symptoms were sufficiently direct; but having such warranty, the fear of doing harm need not deter him. Even if at first the abscess elude his search, he may yet by a little tentative exploration find it, and failing that, he will nevertheless have done good. For the signs, which he has before him, denote tension within the bone, or, if an infant, within the cartilage. This is relaxed by a little opening, and benefit or, at the very least, relief from pain, always follows the procedure. (See Cases LIX., LX., LXI.)

The third question may best be answered while describing the operation. But the surgeon must bear well in mind the exact line of attachment, which in different joints the synovial membrane follows. The head or condyles of the humerus can easily be reached from the front, avoiding the cephalic vein; the olecranon and parts subtending the sigmoid notch of the ulna are easily within reach. Even the head of the femur is attainable; the condyles of that bone are best reached above either lateral ligament; the head of the tibia from either inner or outer aspect of the tuberosity; the lower end also lies patent to surgical aid. The astragalus is easily come upon from either side. The surgeon makes, under a carbolic spray, a little deep crucial or T-incision in the part indicated for each joint, and either with a perforator, or a very small trephine-crown, pierces the bone in a direction toward the place of most projection, tenderness, redness, or whatever other sign leads him to suspect abscess. Let him remember that he is dealing with a cancellous part, and that the opening, however made, need not go far, and but little force should be used. If he use the trephine, he should, on removing the piece, examine its further end for any sign of suppuration, softening, or indeed also of sclerosis. If no pus flow, a straight needle in a handle or holder may be used to explore a little farther and on each side. A very soft part should lead to further perforation in that direction, as indeed should also any unnatural hardness, local abscess being often surrounded by sclerosed bone-tissue. Do not let him hasten this part of his work. When the first weapon used has reached as far as seems desirable, he should take care to search with a fine needle thoroughly, but of course without doing unnecessary violence to the tissues. If the patient be still infantile, this search is not generally necessary; the symptoms will have shown if the brunt of the inflammation be at the epiphysal line or at the centre of ossification. If at the former, the spot whither the pus is tending nearly always marks itself with sufficient distinctness; if at the latter, the only point to be made out is the site of greatest tension. The most convenient instrument wherewith to perforate the cartilage is a small gouge, which, being turned as on a pivot, with a certain pressure removes a little plug of cartilage down to the osseous centre. If the diagnosis have been correct, a few drops of pus or of blood-

[1] Holmes' Surgery of Childhood, p. 427; System of Surgery, vol. iii., p. 751.

stained serum flows away, and all the urgency of the symptoms cease; whereas if the tension be unrelieved, suppuration, with caries or necrosis of the whole bony nucleus, is the almost inevitable result. I have often found great good and great relief follow this proceeding, even when only venous blood has come from the opening in the cartilage, and I have never once seen harm result.

After the operation, a small drainage-tube should be passed to the bottom of the osseous or cartilaginous wound, and the whole dressed antiseptically; the skin-opening should not have been large enough to require a stitch. Twice in my experience an abscess which had been missed opened into the bony channel in five and eight days respectively; but should such event not occur, the drainage-tube may be gradually shortened, and in about a fortnight all will be granulating and nearly closed, the patient in the meantime having lost the pain, the swelling often having diminished. If abscess have been found and emptied, no further anxiety about the result of the case need be felt, although progress, as in all bone-disease except the acute, will be slow. If, on the contrary, none have been detected, we must still watch, but the interference will very likely have prevented suppuration, through relief of tension.

Let me not be understood to say more than I mean. It is not intended to assert, that in all cases of epiphysal ostitis the bone should be perforated; but that whenever such symptoms arise as lead the surgeon with tolerable security to diagnose intra-osseous suppuration, an opening should certainly be made in the bone. No prudent man, be he parent or surgeon, once assured that an intra-osseous suppuration exists, would let blind chance decide whether the pus shall find its way into and destroy the joint, while a skilful hand may assume the guidance of disease and lead it harmless to a safe issue.

If, after a time, whether the bone have or have not been perforated, the synovial membrane becomes inflamed, and if simultaneously or previously starting-pains come on, the surgeon will know that he has the fully developed disease to deal with, and again must consider the possibility of benefit being derived from any of the means already described. Rest must now at all events be employed; the more rigidly, the more acute be the inflammation. If the disease be in the upper limb, the patient is to be allowed, nay enjoined, to move about; if in the knee or ankle, crutches and the high-shoe for the sound side may be advantageously employed, unless carriage exercise can be obtained. The wheeled splint, which is a canvas gutter stretched between iron rods, attached above to an oblique ring, for the top of the thigh, and below to a couple of wheels, is a very useful appliance.

When peri-articular or adjacent abscess form, it should not be allowed greatly to increase; the former species, especially, should be dealt with in a sufficiently early stage. The opening should be free, but antiseptic; and it is well to take the opportunity of examining into the condition of the bone. It may be that a carious surface, or a little opening, will admit the probe into a cavity containing perhaps simply pus, perhaps a sequestrum; in either case exit should be given. If the patient have been chloroformed, and the position of disease render such procedure facile, it may be done at once; otherwise it must be postponed until fitting arrangements have been made. Under no circumstances should a localized caries be allowed through mere want of initiative to spread toward the joint. A necrosis surrounded by abscess is to be dealt with as we deal with foreign bodies setting up suppuration. But we encounter here a question upon which surgeons

somewhat differ; namely, whether or not it is wise to cope with such condition before the sequestrum has become loose. I myself am very decided upon the point, that a sequestrum, clearly distinguishable from the neighboring living bone, should, if near a joint, be removed as soon as possible, thus avoiding the dangers of pus-accumulation in a cancellous bone without adequate outflow. Even if the sequestrum form part of the joint-surface, I still recommend its removal, for by this time the articulation, as an apparatus of motion, is destroyed; delay can only add further risk to the patient's limb or life. Subsequent care must be taken lest the wound contract too readily, preventing free exit of discharges or of débris.

With the exception, however, of keeping a careful watch upon the osseous conditions, and taking the earliest opportunity of removing diseased bone, or relieving suppurative tension, the treatment of the second and third stage of osteo-arthritis is, unlike the first stage, very similar to the management of strumous synovitis. In the later phases of both maladies we have to do with disease of both the hard and soft constituents of the joint. If suppuration and soft granulation produce tension, if the skin be white and lifeless-looking, we have yet a resource, before considering or, at all events, before proposing any method of removal, viz., free incision; in ostitic disease the finger should afterward carefully investigate the state of the bone, the possibility of a sequestrum projecting toward the joint, the existence of intra-osseous sinus, and those other points already described. A perfectly antisepticized finger gently introduced through such an incision does no harm. Even if nothing indicating further remedial measures be found, it will have secured the absence of any septum of false tissue behind which pus may be stored. Nevertheless, when ostitic joint disease has reached this phase, it is, even with the resource just named, less hopeful than a synovitis in a similar state of suppurative decay.

When caries and necrosis affect small bones entering into the composition of joints—such as those of the tarsus and carpus, even in young children the elbow—a somewhat different form of treatment is occasionally valuable; as it may be substituted for excision, and, when successful, usually leaves a fairly useful limb. When abscess, especially if on both sides of the articulation, has formed, has been opened, and *caries necrotica* of the small bones or epiphysal ends has been verified, the surgeon, instead of removing or gouging the diseased parts, may draw, right through the joint and neighboring disease, a wisp of tenax, only taking care that the skin-opening is wide enough to let this lie in the wound without tension, and indeed with a little room to spare. A free dischage of pus follows, and every other day, or more often, the oakum is drawn a little through the wounds. Very shortly the fibres entangle and bring away portions of necrosed bone, and after a time, if the treatment be successful, clears away all the diseased parts of bone, leaving healthy granulations behind. The condition of parts therefore must be from time to time investigated with the finger, and when it impinges no longer anywhere on bare bone, but on velvety granulation-tissue all around, the tenax must not at once be discontinued, lest some false healing and imprisonment of pus take place, but must be little by little diminished until a mere strand, and ultimately none, is left. He who has never used this method will probably be surprised at the rapidity with which, once the sequestra eliminated, even large gaps will fill; therefore he must be very careful to keep the parts in a useful position, lest, before he is prepared for it, a twist or bend into some awkward posture take place.

Case LIX.—James E., aged four, came under my care with disease of the knee, March, 1878. The joint was bent to little over a right angle, and any attempt to straighten it produced violent screaming. There was some thickening of the synovial membrane, but the chief swelling was at the inner tuberosity of the tibia, which was much enlarged. The limb was placed on a splint, and strong tincture of iodine was applied every morning; after the fifth application this had to be discontinued, and was re-applied three times after five days.

March 13th.—The head of tibia was increased in size, and the knee was rather more swollen; one spot on the tibia seemed especially tender, but there was some tenderness over the whole inner surface. For the last five nights starting-pains, marked by waking with a sudden scream, occurred several times. He was ordered three grains of iodide and three of bromide of potassium.

April 5th.—Under the carbolic spray I cut down to the tibia, and with a small gouge removed a portion of the cartilage down to the nucleus. The Esmarch bandage having caused the soft parts to be dry, the escape of a few drops of blood-stained serum was evident. The wound was dressed antiseptically, a drain being left in the cartilaginous opening.

April 20th.—A probe was passed into the opening, which was discharging a thick creamy pus. The osseous nucleus, or a portion of it, felt to be necrosed and loose, was extracted with a pair of dressing-forceps. A good-sized drainage-tube was left in the cavity.

May 16th.—The excavation in the cartilage gradually filling with granulation, drainage-tube was shortened, the synovial swelling decreased. The child recovered rapidly.

Case LX.—Henry W., aged twelve, admitted February 26th into Charing Cross Hospital, under my care, with disease of the knee-joint.

About four months ago he first noticed a little hard swelling on the inner side of head of right tibia. He was treated in a London hospital by iodine paint; the part still enlarged. About a fortnight ago the knee-joint itself became painful, and he could not move it well.

The enlargement on inner side of tibial tuberosity was considerable, the skin over it slightly red. Very severe pain, irregularly paroxysmal, was generally followed by swelling of the knee, which afterward subsided if there were three or four days' interval without the pain; but the attacks were becoming more frequent, the knee was getting stiff, also enlarged.

March 11th.—The swelling both of the bone and the joint was evidently increasing. I therefore cut down and trephined the head of the tibia. There was a tolerably thick layer of cartilage; and when the bony nucleus was reached, some serum, slightly blood-stained, flowed away.

April 1st.—There was no sickness, pyrexia, nor pain. The bony enlargement slowly but persistently subsided; the knee-joint was normal.

April 24th.—Left for a convalescent home, the wound having healed, and the only abnormal condition was a somewhat enlarged tibia.

Case LXI.—Percy F., aged eleven, admitted under my care into Charing Cross Hospital, February 24, 1880, with diseased knee, which had been going on for five years. It had been nearly painless, except when abscess about the outer side had formed. The last of these commenced three weeks previous to admission, and burst, leaving two ragged ulcers, the larger about the size of a shilling.

The knee was considerably enlarged, the synovial tissues a good deal

thickened; the chief increase, however, being about the outer condyle. The outer tuberosity of the tibia was also slightly enlarged.

Right knee at level of patella	$12\frac{3}{4}$ inches.
Left	$10\frac{1}{2}$ "

The joint was almost immovable. There was no tenderness, save on the outer condyle.

March 4th.—I laid the two openings into one. There was no sinus leading to the bone; I cleared the soft parts and examined its surface, but could find no cloaca; yet one spot was soft, so as to give a sense of being impressible by the nail. Here I applied a small trephine, and opened a cavity in which lay a loose necrosis of the cancellar portion. A little enlargement of the opening was necessary, in order to remove the sequestrum, which was the size of a small Barcelona nut. The operation was performed, and the boy dressed antiseptically. He had no temperature or other bad symptom, and after the first three days hardly any discharge.

On the 23d the wound nearly healed and granulating; antiseptics discontinued.

March 27th.—Drainage-tube left off.

April 1st.—Convalescent.

Case LXII.—Jane F., aged thirteen, came under my care into Charing Cross Hospital, May 3, 1874, with disease of the ankle-joint, from which she had suffered intermittingly for about four years, at which date, it appears, she received a kick on the inner ankle-bone.

The whole surroundings of the joint were much swollen, with the anklet-like appearance of joint-affection. The enlargement ran only slightly up the leg, but extended behind and below the malleoli more than half-way to the sole and to the tip of the heel, in front as far forward as the medio-tarsal joint. The swelling was soft, chiefly marked on the inner side, where increased size of the lower end of the tibia was perceptible, more especially in front, where the malleolus joins the rest of the bone. Here, evidently, was the chief seat of disease. The prognosis being very unfavorable, the joint was nevertheless enveloped in plaster-of-Paris, first surrounded by two layers of wadding. She was sent to the sea-side.

June 9th.—The plaster splint was renewed in the interval, and at the above date was taken off. The general swelling was somewhat harder; but in front, just above the joint, and behind at the outer side of the tendo-Achillis, abscesses were pointing. These were opened, and a probe passed from the front one into the tibia, from the back one into the articulation. The foot permitted of abnormal movement at the ankle-joint, and bony crepitus was distinct. A careful examination verified the absence of bony crepitus in the tarsal bones, except the astragalus.

June 22d.—Excised the joint. On examining the truncated surface of the tibia an abscess was seen, in the centre of which was a sequestrum which had been divided by the saw. It ran some way up the bone, through the epiphysal line, and, as far as could be judged, appeared to commence on the distal (the epiphysal) side of that line. The articulating surface of the tibia was quite bare of cartilage, save on the malleolar surface, and in most parts the articular lamella had given way. Through two of these openings the osseous abscess communicated with the joint. The astragalus was also denuded of cartilage, except on the lateral surfaces. The synovial and perisynovial tissues were stuffed with and converted into granulation-tissue, which also invaded the tendinous sheaths lying behind the tibia.

The child did well; the termination of the case is reported in Chapter XX. I cannot but think that had it been possible to detect the abscess earlier, and to perforate the bone, a chance of saving the joint might have been afforded.

Case LXIII.—Emma G., aged nine, came under my care into Charing Cross Hospital, July 10, 1877, with diseased knee.

The child was tall, thin, and ill-nourished, but not cachetic. The right knee was considerably swollen. Examination, however, showed that the synovial membrane and soft structures of the joint were but slightly affected, while the inner tuberosity of the tibia was considerably enlarged. This part was tender on pressure, and at one point more especially was a slight increased projection where tenderness was extreme. The knee was movable through a small range, but beyond this the muscles contracted spasmodically, the child screams and says it hurts her, referring the pain to the upper end of the tibia.

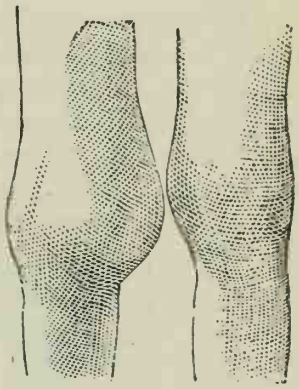

Fig. 35.—Ostitis of tibia.

July 19th.—I made a T-incision over the point of most swelling, turned aside the flaps, and with the scalpel cut out a circular piece of cartilage down to the bone; at this point the probe showed the osseous tissue to be soft and pultaceous. All this softened part was removed with a gouge, nor did I desist until the probe, unimpeded, struck on healthy hard tissue. A drainage-tube was placed in the opening, the antiseptic dressing applied, the knee placed nearly straight on a splint.

July 21st.—There had been, since the operation, neither pain nor fever.

August 17th.—The wound—with the exception of a small part, the exit of the drainage-tube—was healed. The slight swelling of the synovial membrane had greatly diminished.

October 2d.—On my return to town I found the child well. The inner head of the tibia was still a little large, and doubtless would remain so for some months. It was not tender unless the scar was directly pressed upon. The swelling of the joint itself had quite disappeared. The limb could be moved without pain through very nearly its entire arc.

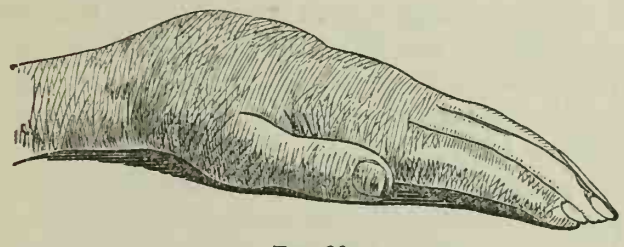

Fig. 36.

Case LXIV.—William Butcher, aged twenty-eight, from Alford, near Guildford, came into the Charing Cross Hospital, March 13, 1860, with disease of the right wrist.

About ten months previously the wrist became painful; he thought he sprained it, and tried pumping on it. At last, not being able to work, he had to go to the Union: the medical man lanced the wrist once and applied linseed poultices. Starting-pains came on about a month after the beginning of the disease. The wrist was much swollen and shapeless; the tendinous sheaths, both at the back and in front, participating in the swelling; the whole was puffy and doughy, with harder and softer parts; the end of the ulna was enlarged; over the back of the metacarpal bones of the index and ring-finger behind there was a greater tumefaction, which fluctuated; over the back of the unciform there was the mouth of an old sinus.

It was explained to him that there was little probability of being able to save the wrist; but before having recourse to the last resort he wished to have some means tried. It was determined to use the actual cautery, though without hope of checking the suppuration then going on in the bones. Accordingly, under chloroform, three lines were drawn with the hot iron.

April 16th.—The cautery lines all healed; but, as expected, no improvement took place.

May 5th.—I amputated about an inch and a half above the wrist-joint, and afterward examined the part.

Examination.—Tendons of extensors with their sheaths of thumb and index healthy; common extensors matted together by soft tissue and suppurating; an abscess over commencement of metacarpal bones of index and middle finger, which had not penetrated through the skin: flexor tendons also matted together and suppurating; tendons of extensor carpi ulnaris sound; periosteum over the end of the ulna much swollen and puffy; the bone itself carious all round, studded with holes and little osteophytes. All the bones of the carpus surrounded by pulpy tissue of synovial membrane; articulating surface of the radius deprived of cartilage, rough, carious, and covered with pink pulpy tissue (granulations). First row of metacarpal bones on the surface, where they articulate with the radius, carious, deprived of cartilage; on their other articulating surfaces partly deprived of cartilage and carious; in some parts the cartilage still remaining was thin and sodden, here and there detached from the bone: the semilunar and the scaphoid were quite soft, converted into a fleshy mass with thin network of bone running through it. The second row of bones were also carious, but in a less advanced condition, more of the cartilage remaining than on the first row; the cartilage throughout could be stripped off like thin tough membrane, and left beneath a pink pulpy material (granulation from the cancelli).

Microscopic.—The synovial membrane was converted into a structure consisting entirely of round, nucleated cells, bare nuclei, and granules; the tissue upon the bones in the absence of cartilages, also that which was left when these were stripped away, was precisely the same. The cartilage itself, thus thinned, had, for the most part, undergone fatty degeneration; the cells were in some places full of oil-globules; in other parts, and these next the free edge, the whole corpuscle was full of oil, the cells having apparently, deliquesced; in other parts of the section the condition was one of atrophy, the corpuscle and the cells being very small; the hyaline substance is fibrous wherever the cells are fatty.

The carious bones had their cancelli filled with pulpy granulation-tissue and pus; the bony walls very plainly laminated; lacunæ enlarged, light, full of nucleated cells; canaliculi large, as a rule; Canada balsam penetrated very easily.

The following case occurred before I had conceived the idea of paracentesis ossium. I believe that much time might have been saved and risks avoided had this means been used.

Case LXV.—Alice Blackman, aged six, came to me at the Charing Cross Hospital, December 14, 1859, with pain of the right knee.

The only change in form about the joint was that the inner femoral condyle was somewhat protuberant; on examining it by touch the tissues over that part were found thickened: the child cried with pain when the joint

was moved: more particularly if it was either bent or straightened beyond a certain point. Pressure upon the inner condyle produced more pain than equal force exerted on the other. The child was fat, dark, coarse-featured, with swollen lips, red edges to eyelids, and large joint-ends to the bones generally; the left knee, sound, was inclined to bow inward. She was ordered to take a purge of calomel and jalap; to have a splint, nearly straight, applied to the outside of the thigh and leg; a blister above the seat of pain; to be dressed with the iodide of potass ointment.

December 30th.—The child came back as directed on the 16th. She had been getting better, but at this date the complexion was thick, the breathing short, and throat stuffed with mucus; there seemed, also, more pain in the joint.—Ordered another purge of calomel and jalap; when its action was over, to take quinine and gray powder.

January 6, 1860.—She took the pills for four days; much better, less heavy, complexion clearer. Return to the quinine and acid; to paint the inside of the joint with tincture of iodine.

February 17th.—The child well; the joint has not been inflamed.

June 8th.—Alice Blackman fell down-stairs, and came back to the hospital with some little injuries; she at the same time hurt her knee, and the pain in it makes her cry a good deal, especially at night. The inner condyle was altered in shape, as could be detected by the sense of touch; but it was hardly more protuberant; it was tender on pressure and hot. She cried when the knee was moved more violently than before. A nearly straight pasteboard splint to the outside of the thigh and leg; a blister above the inner condyle; to be dressed with zinc ointment; iodide of potassium mixture to be taken three times a day.

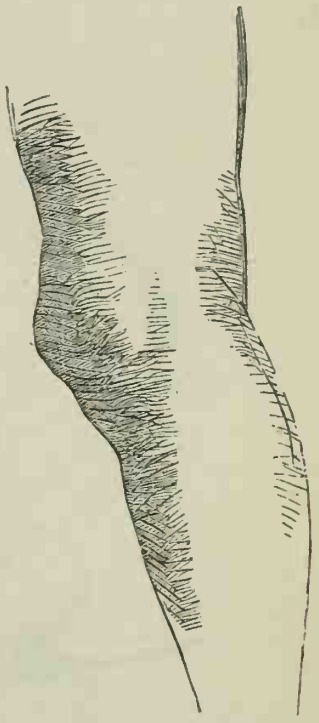

Fig. 37.—Ostitis of inner condyle.[1]

June 20th.—She had another blister over the seat of pain; there was less tenderness, but the child cries at night a good deal. It appeared that she did not wake up suddenly, but had some difficulty in going to sleep; when she woke, she did so with effort, and cried. It was evident that these were not the starting-pains, but only the dull aching of the earlier stages. Ordered to paint the joint with tr. iodinii; to continue the mixture, and to return for a week to the tonic medicine.

June 25th.—There has appeared over the most prominent part of the inner condyle an increased tumefaction, which fluctuates; the fluid is deep. There are at present no pains which appear like starting of the limb. The joint was drawn at this time.

July 2d.—The whole joint was swollen and puffy; the enlargement did not depend upon fluid effusion in the cavity, but on peri-articular thickening; the tenderness over the inner condyle rather less. The child looked better. Apply blister round lower part of thigh in front.

July 6th.—The pain over the condyle, and the fluctuating swelling, appeared less; but as the peri-articular tissues were implicated, I desired to

[1] The abnormal projection of the inner condyle is somewhat increased by a serous effusion under the periosteum.

treat, also, that condition. Gave the child chloroform, and applied the cautery-iron in one line at the outside, two at the inside of the joint.

July 20th.—Child better: the wound from cautery almost healed, and much less tenderness about the joint. To take one tablespoonful of quinine mixture three times a day.

August 17th.—The joint had been strapped tightly for the last ten days, and the splint removed; the child had ceased to cry at night; the inner condyle was scarcely, or not at all, more susceptible of pressure than that of the other side, and the peri-articular fulness has disappeared.

September 19th.—The child's joint perfectly sound.

Case LXVI.—Jane Dickery, aged thirteen, a thin, weak-looking child, having finely cut features, small bones, and veins plainly marked about the mouth and temple, was brought to me May 30, 1860, with the left shoulder painful and swollen.

The swelling was very evident; it made the shoulder look rounder, larger than the other, and somewhat pointed in front, and a little to the

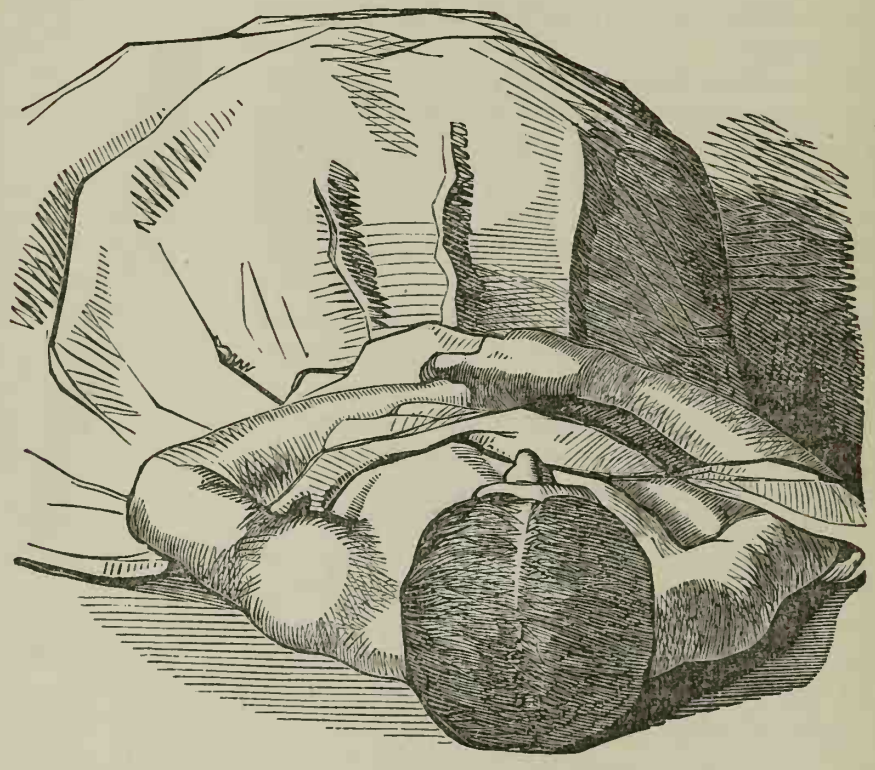

Fig. 38.—Strumous ostitis of the head of humerus.

outer side. This was best visible when the patient sat upon a low seat and the surgeon looked down upon her from above, thus obtaining much the same view as is given in the accompanying drawing, which was taken with the child lying on her back. The shoulder was tender on pressure, and hot. She was ordered a teaspoonful of cod-liver oil, and two tablespoonfuls of quinine mixture, three times a day; a blister to the front of shoulder; the arm to be bound to the side.

June 9th.—Appetite improved. She had, since last report, a blister behind the shoulder: a superficial abscess formed over the acromion of the other side.

June 16th.—Again a blister to the front of the shoulder; to be dressed with oxide of zinc ointment.

June 30th.—Better: the abscess over the right acromion had broken and left a superficial ulcer: to let the blister heal; the arm no longer to be bound to the side, but to be kept in a sling.

July 13th.—The shoulder diminished in size very much; it was neither now tender nor hot. Passive motion and friction.

September 7th.—There was some trouble in overcoming the stiffness, and difficulty in moving the shoulder; but it was ultimately rendered as freely movable as a healthy joint, though the head of the humerus did not regain its normal size, but remained little larger than normal. I procured an admission for her to the Walton Convalescent Hospital.

CHAPTER XII.

ARTHRITIS DEFORMANS.

Pathology.—The more usual names for this disease—Chronic Rheumatic Arthritis, Rheumatoid Arthritis, or Rheumatic Gout—appear badly adapted, since they all connote a pathological relationship, which is, to say the least, not proven, and because they fail to indicate the chief characteristic of a disease in which the bone-ends are frequently so altered that heads which should be globular are flattened and broadened to the shape of toad-stools; cavities that should be spherical are shallow or ovoid; capitella change to hollows; trochlea become pyramidal; and sigmoid notches span twice their normal grasp. On these altered joint-surfaces little or no vestige of cartilage remains; the bare bones, in places polished, are studded with little openings, like worm-holes. The necks of long bones shorten and change their direction, while from them and even form the shafts sprout irregular osteophytes, which, interlocking with those from the neighboring bone, form buttresses and struts, greatly impeding or preventing motion. Therefore that a joint-inflammation (an arthritis) is present may be with certainty affirmed; the participle "Deformans" is well chosen, and indicates the strange, even grotesque, results of the disease.

The first mention of the malady dates back to a hundred years ago; for in his short clinical history of the "Nodosity of Joints" (London, 1805), Dr. Haygarth says: "It is about twenty-six years ago since I wrote a description in a paper"—which was read at a small professional society in the West of England—in the year, therefore, 1779. He speaks of it as "a troublesome disease of the joints, clearly distinguished from all others by symptoms manifestly different from the Gout, and from both Acute and Chronick Rheumatism." He goes on to say that the disease has occurred in 34 out of 10,549 patients; is almost peculiar to women whose catamenia are ceasing. In the 34, only one was a man, aged between fifty and sixty, who had the nodosities only on the fingers, he having fallen on the hand a short time previously. Women have more joints affected, principally, however, the fingers. "They (the nodosities) more commonly attack persons in the higher and middle class of life."

It is, however, chiefly to two Dublin surgeons, Mr. R. W. Smith and Mr. Robert Adams, and to my colleague Mr. Canton, that we owe valuable labors and much minute investigation of the disease; and to the last named more especially the explanation of many instances of deformed joint-bones which were previously considered, sometimes as the result of peculiar dislocations, sometimes of a bastard gout or syphilis, sometimes simply—and here Mr. Canton's investigations are more especially valuable—as the result of senile change.

The disease is essentially one of later life. Although a few cases occur before the age of forty, they are exceptional, and are then a sequela of some febrile attack, or of disorders of menstruation. Moreover, it is more com-

mon among men than among women, and affects the poorer rather than the upper ranks of society. The discrepancy in this statement with the description of Dr. Haygarth is only too striking. With regard to the class of society, it will be remembered that the practice at Bath was, as now, chiefly among persons capable of bearing the expense of a stay in that city, and therefore Dr. Haygarth saw people from a distance affected with gout and rheumatism, or symptoms ascribed to those diseases; while the poorer persons of the district itself are, from the nature of the climate, not very prone to the disease. For the difference in regard to sex it is difficult to account; something may be due to a mere fortuitous concurrence of female cases; something to inaccurate diagnosis; for Dr. Haygarth does not appear to have examined any cases anatomically; or, again, it may be possible that the larger indulgence in stimulants, especially in port wine, practised at that time by the well-to-do males, may have developed into true gout what would otherwise have culminated in *Arthritis deformans*. At the same time it must be well known to every practitioner that women of all classes, but chiefly, I think, of the upper classes, whose catamenia have ceased rather suddenly, especially rather early, are very prone to this form of disease. However that may be, there is no doubt that males of the poorer class are most of all subject to the malady, and that its chief habitat is a damp, chilly climate.[1] I have not heard of any instance of its occurrence in hot or dry places, such as Hindostan, Spain, etc. Most commonly the disease is poly-articular, but may also be set up in a single articulation by injury, such as fracture into or close to a joint, even by severe blow and strain; and from this one spot the action occasionally travels to other joints. Thus it is evident that the disease, though usually constitutional, may also be merely local. When constitutional, the immediate provocative is usually a long exposure to damp and chill, more especially if combined with scanty food; or a very much less exposure when the system has been depressed by some fever, be it exanthematous or rheumatic. Again, a certain number of cases occur without any traceable cause whatever. Once fairly and fully established, the disease suffers no abatement; treatment may retard the progress—may indeed prevent the spread to other joints—but once fully set up in any articulation, it hardly permits of much alleviation; the alterations in form, when once they have taken place, are irremediable.

The most conspicuous of the changes fall upon the bone; but it is impossible to give here an exhaustive account of their infinite varieties. The key to them lies in the unstable ratio between atrophy and hypertrophy. The former takes place where there is pressure, the latter where there is none. A convex joint-surface may thus grow in breadth by marginal additions, while the central parts, subjected to pressure, may become flat, even hollow. But if position or a strut-like growth prevent pressure, such a surface may assume an almost conical shape. Similarly variable conditions may cause a cavity to become either deeper or more shallow.

Peri-synovial and ligamentous tissue are in the earlier stages simply inflamed and thickened; later, this thickening in most parts is greatly increased, the tissue becoming like fibro-cartilage, or yellow ligament. In other parts considerable absorption may have taken place, so that a large ligament, like the internal lateral of the knee, may be left as a few more or less disconnected shreds. Later on, both in parts that have suffered ab-

[1] Sir Benjamin Brodie describes it as being common among the upper servants, hall porters and tall footmen, of large London houses; but a perusal of his cases leaves no doubt that he did not clearly distinguish this malady from gout proper.

sorption and in those that have undergone thickening, there takes place in many cases a singular growth (not a mere calcareous deposit) of bone, which commences at the attached border of the capsule, and gradually spreads more or less over the whole structure, so that the joint-ends may be described as enclosed in an imperfect and fragmentary sheath of bone. Some of these fragments are provided with a thin layer of cartilage facing the joint-cavity. Thus, we have three phases: 1. Mere inflammation. 2. Thickening with condensation in some parts, and absorption in others. 3. Bony metamorphosis. In any one of these conditions it may be observed that the whole capsule is enlarged either from a pre-existing hydarthrosis, or from a peculiar bony growth, to be described hereafter.

Intra-capsular ligaments and tendons rapidly disintegrate or become absorbed. This is perhaps most markedly exemplified by the ligamentum teres of the hip and the long tendon of the biceps, a little less conspicuously by the crucial ligaments of the knee. These ligaments are either entirely or only partially absorbed; being detached at one end (at the hip generally, from the femoral, at the knee from the tibial), they are frayed out and unravelled. The intra-articular part of the biceps tendon is either absorbed, and the lower end gets a new attachment in the bicipital groove, or it is dislocated inward, or it is split up and flattened, its separated fibres passing in various positions over the head of the bone. The cotyloid ligaments both of shoulder and hip are, according to R. Adams, quite absorbed.[1] I believe them to be quite as frequently converted into bone, and I possess a specimen, a traumatic case, in which such ossification is evident in the cotyloid ligament of the hip. Intra-articular cartilages are, as a rule, absorbed, though more rarely they may be found ossified, even hypertrophied.

The *Synovial Membrane* is, like the subsynovial, thickened; and many of the bony growths above mentioned protrude into it, or rather through it, so as to take its place here and there, the surface which is toward the joint lying bare in the gap of membrane. In the earlier phases it is red, the vessels being gorged with blood; later, the general surface is paler. Around the margin, where it joins the bone, very large papillary growths sprout in the greatest luxuriance, sending forth secondary buds, some of which contain cartilaginous or osseous bodies, more or less sessile, only attached by a thin stalk, or just ready to break away and become loose. These are (see Chapter on Hydarthrosis) hypertrophied synovial fringes, and are usually confined to the points above mentioned; but occasionally the whole inner surface of the membrane is thus covered, presenting a singular hirsute appearance, like a sheepskin mat.

Cartilages.—The tissue-changes of cartilages are very singular, and in many points unlike those that occur in any other disease; unlike not only in their nature, but also in the strange admixture of atrophy, hypertrophy, ossification, fibrillation and fatty degeneration occurring in patches throughout the structure. We may, however, localize somewhat these processes thus: hypertrophy, which is, as we shall see, much mixed up with bone-changes, hereafter to be discussed, takes place as a rule where there is no pressure, chiefly, therefore, at the edges of the structure which grow outward—*i.e.*, centrifugally, often in a more or less regular, frequently in a most irregular manner; we will call this marginal hyperplasia. This newly grown part ossifies rapidly, giving rise to the ensheathing or to the nodose form of overgrowth (Figs. 39 and 40); mingled with this hyperplasia are

[1] On Rheumatic Gout, p. 33, econd sedition.

patches and lines of fatty degeneration. In these spots the cartilage rapidly disintegrates and becomes absorbed, the chasms thus produced helping to divide the craggy projections from one another, and aiding the nodose appearance. Those parts of the cartilage which are exposed to pressure undergo, not throughout the whole structure, but in places here and there, inflammatory atrophy, fibrillation and ossification from the deep surface. Thus, a certain part will be converted into bone, in the middle of which a patch of fibrillated cartilage will be found; while, next it, perhaps, may lie some remains of cartilage, still smooth but excessively thin, because ossification has reached from its depth almost to its surface. The fibrillation is peculiarly coarse, the cartilage corpuscles are greatly enlarged and filled with proliferating cells. The ultimate outcome, however, of these changes is that by one or the other process, or rather by all of them intermingled, the joint-cartilage ultimately disappears from both surfaces, leaving the naked bones to rub against, to polish, or to roughen each other, according to their mutual juxtaposition.

The Bones undergo such remarkable changes that the morbid anatomist's chief interest must be concentrated upon them. They are inflammatory hypertrophy and atrophy, so intermingled as to produce, together with the marginal cartilaginous hyperplasia, the most singular changes of shape, and, in a certain sense, peculiar alterations of structure. Hypertrophy takes two forms, either interstitial (induration) or enlargement. Atrophy may either be exhibited as rarefaction or absorption.

Of hypertrophies, the interstitial variety takes place where there is friction; it is therefore found where two surfaces move on one another. It gives to the bone an extreme density, termed eburnation, or porcelanous deposit, and enables it to take a high degree of polish; it is merely a surface condition. In certain ways it is different to the osteo-sclerosis of ordinary inflammation, being in part produced by deposition, in the Haversian canals and other natural cavities, of bone-earth barely mixed with organic parts, but in the finest subdivision. This deposit is sometimes so abundant as to strangulate the vessel of the canal. It is often combined with absolute diminution of size, or "wearing away," as some have called it; also it is generally in mere small patches, scattered among other patches of rarefaction. Hypertrophic enlargement is chiefly mixed up with the marginal hyperplasia of cartilage, yet takes place *ab initio* in any spot which, by the growth of neighboring parts, may have been relieved of pressure; for—and I cannot too strongly insist upon this fact—the changes of form in the joint-surfaces proper are the result of adaptive hypertrophy and atrophy, regulated entirely by pressure.

A very singular phenomenon, resulting from the naked condition of bone-surfaces, combined with interstitial hypertrophy or eburnation, is the fine polish which continued friction induces. Sometimes these burnished plates are on rather small scattered blotches, but more generally in spots of larger size, or in lines of alternating depression and elevation—ridge and furrow. In hinge-joints, as at the knee, these lines run on tibia and femur, from before backward; on the patella, from above downward. In arthrodial joints they assume a spiral or cycloid shape. Often they may be demonstrated as a polishing of the ossified articular cartilage; in other cases they are situated on the bone-structure proper, whose cavities have been filled up by interstitial deposit, which are nevertheless undergoing dimensional atrophy, and on which very frequently the worm-holes left by extinct Haversian systems are somewhat plentiful. This admixture of interstitial induration, together with wasting and diminution in size, is very

singular; and yet so constantly are they both associated with wear and polish of surface, that we may almost affirm, whenever we see burnishing of bone or of ossified cartilage, that there is taking place not only the ill-organized porcelanous deposit, but also diminution in size.

Interstitial atrophy, although it always accompanies, must be distinguished from dimensional atrophy, because it also takes place in parts which are not decreasing. It is marked by increase in size of all the natural cavities, until what was solid bone becomes a mere reticulation of thin lamellæ; a change best seen on section, while on the surface this condition is chiefly marked by round holes, like those in worm-eaten wood. They are the places whence Haversian systems have disappeared in whole or in part. Such holes may be in the midst of eburnated bone, leading to reticulate spots of atrophy lying next to or immediately beneath a layer of burnished porcelain. As the polished layer wears away, new deposit on its deep surface takes place, and thus the eburnation encroaches on atrophied, and this latter on healthy parts, the bone-tissue itself gradually disappearing.

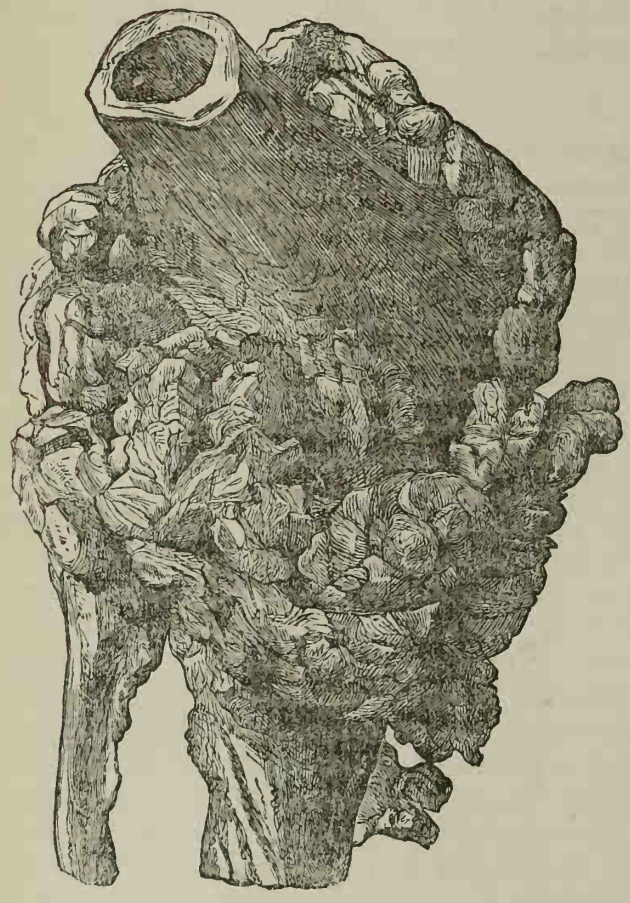

Fig. 39.—Marginal hyperplasia (after Canton).

These two forms of hypertrophy and of atrophy, combined with what I have called marginal hyperplasia, may, by the careful study of specimens, recent and otherwise, be shown to effect all the changes of form characteristic of this disease, which, though so various, are all produced and carried out on one and the same plan. Thus, at the knee here depicted, irregular marginal hyperplasia is more especially marked, the result being a craggy outgrowth of additamentary bones, which surround the joint proper, and by their buttress-like action preclude movement, without anchylosis, which never or very exceptionally takes place in this disease. This form of hypertrophy (marginal hyperplasia), which produces, according to certain circumstances, either this craggy or a peculiar ensheathing bone-formation, (see Fig. 40) takes place thus. As soon as the inflammatory act has reached the stage at which the cartilage begins to participate, the cells of that structure proliferate freely. Where the bones exercise a mutual pressure, this action leads to absorption of the tissue, as we have just seen; but at the margins, where there is but little or no pressure, and where the vascular supply is large, the excited cells gather around them new hyaline matter, so that this margin, growing centrifugally, either overhangs or encases the bone near the joint-surface; or, if the irritant be more potent, produces a crop of uneven nodules which might be termed ecchondroses, did not ossi-

fication follow close upon the cartilage growth. This conversion into bone takes place with great rapidity from the deep surface, while growth still goes on from the superficial face. Until the whole knob is ossified, growth continues ; so that during the progress of the disease these lumps are, internally and on their deep surface, bony ; superficially, cartilaginous. The older ones, which have stopped growing and lie nearest the joint-surface proper, are generally in contact with similar outgrowths from the fellow-

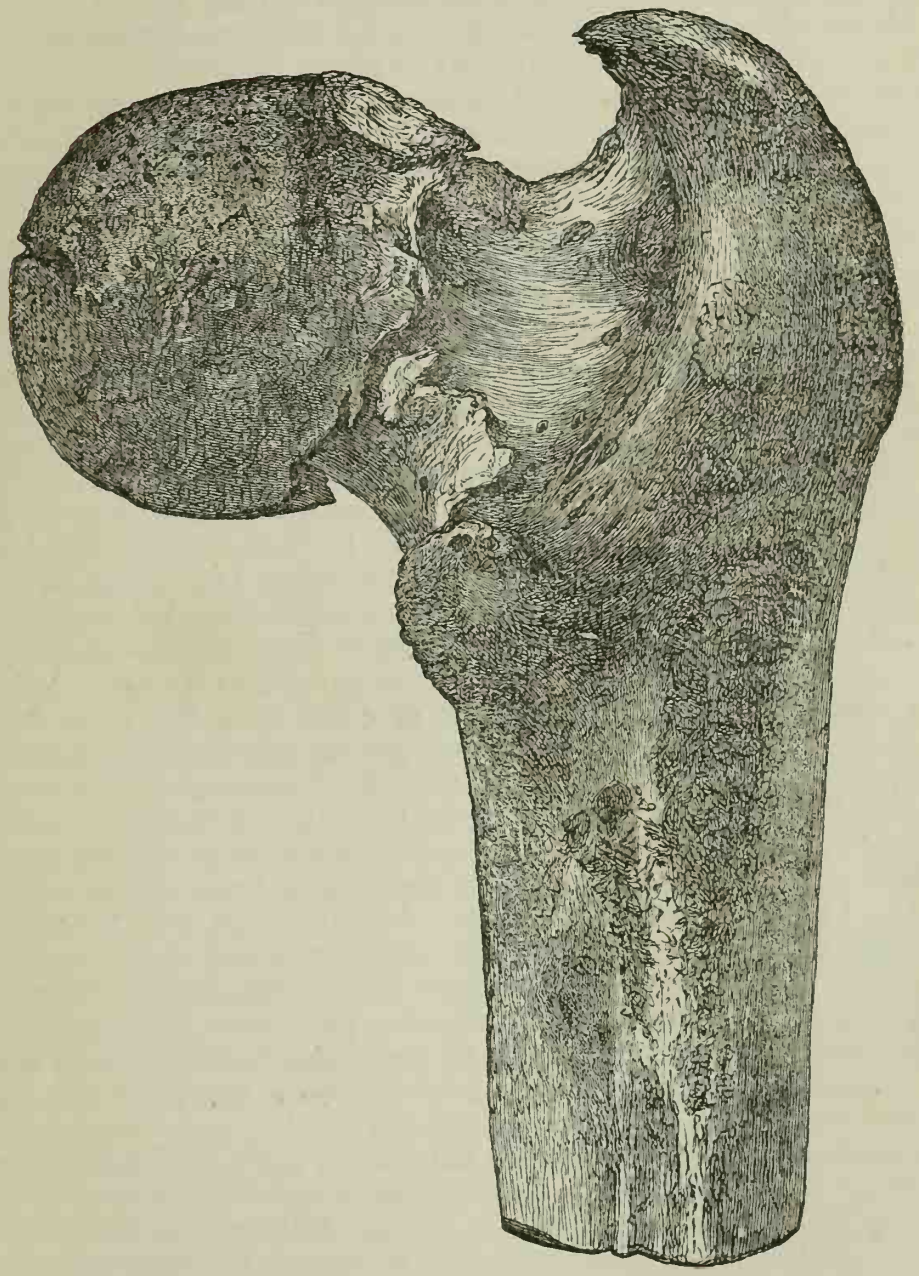

FIG. 40.—Ostitis deformans. Plates from margin of the head ensheathing the neck.

bone ; these two parts coming in contact mould each other by mutual pressure into dovetailed forms, which act as a kind of outriggers to the true articular faces, increasing and adding to their breadth in every direction. It must be remembered that this hyperplasia takes place from the margin of the articular cartilage, *i.e.*, from a part within the synovial membrane, and that the resultant growths are therefore within that structure, which they, however large they may become, push outward and distend.

Herein they differ from those osteophytes, which are frequent in other joint diseases, which are merely deposited by the periosteum, and which are extra-articular. Now, if with this broadening out of the margin, be it of a head or of a cavity, considerable absorption, in the former instance, or hypertrophy in the latter, be combined, we see very plainly how it happens that rounded heads like that of the femur or humerus must necessarily become flattened or mushroom-shaped, while acetabular or glenoid cavities become wide and shallow. But such changes of form do not stand alone; they are associated with change of place; for instance, the acetabulum migrates upward and backward, so as to lie above Nélaton's line. That is to say, that at the upper part, most exposed to pressure, atrophy takes place, the bone is absorbed at that point of the periphery, while downward and forward, where there is no pressure, bone is deposited, and thus the whole cavity shifts its position.

But most singular are the changes occurring at the head of the femur, which are such that the bone looks as though its neck had been absorbed, and had become so soft as to yield to the weight of the body, and to bend down to a right or acute angle with the shaft. I need scarcely say, that this is not the real explanation of the abnormal form—the truth being not that the neck, but that the head of the bone is absorbed, and that what, in the fully developed disease, takes the place of the head is an enormously hypertrophied neck. Let me refer to Fig. 40, from a specimen I have chosen, because it represents the malady in a form just far enough advanced to indicate the method of change. In that drawing, the border of the joint-surface is prolonged outward by marginal hyperplasia and encases the neck of the bone, while the round worm-eaten little holes on the upper aspect of the head indicate that atrophy at this part has commenced. The ovoid form of the caput which looks due to growth in length is a prolongation of bone from the cartilage margin over and upon the neck, chiefly indeed on its lower aspect. The next phases are increased absorption of the upper aspect of the head, and fresh growth at lower part of neck, the result being that the head falls to a lower level and encroaching on the neck lies between the trochanters. The appearance is as of a head sessile and depressed upon the trochanters; the reality is a head almost entirely absorbed and replaced by a tumid neck. Like changes take place at other joints; among them at the metacarpo-phalangeal and at the inter-phalangeal joints. They very often commence quite early in the disease, affecting by hypertrophy and atrophy the outer and inner sides respectively of the first-named articulations, so as to press the fingers over to the ulnar side. In the further development of the disease at this place very singular and characteristic distortions are produced.

Carefully as I would avoid, when possible, differing from such an authority as Professor Volkmann, I cannot agree with his reasoning from these facts that the malady commences in the synovial membrane, though it is true that clinically the first appearance is often a synovitis with effusion. The fact that adjacent bones such as the acromion and coracoid process participate in the action, and even aid in forming the abnormal socket, and that inflammation, identical even to the formation of tufts, takes place in the neighboring tendinous sheaths, preclude the possibility that such widespread influence can arise from mere synovial irritation. When, too, we look at the microscopic illustrations to Sir J. Paget's paper "On Ostitis Deformans,"[1] and at the bones involved, we cannot help observing a re-

[1] Med. Chir. Transactions, vol. lx., p. 37.

markable similarity, although the irritant of movement being in that case absent, because the shafts and not the joint-ends were attacked, no additamentary bones were formed.

On the other hand, one may, as I have already stated, doubt the existence of such a thing as a "panarthritis," if by that term be meant an inflammation which attacks simultaneously and equally every one of the joint structures.

I would rather ascribe the malady to ostitis, originating in some constitutional cachexia, which resembles the rheumatic in its tendency to fibrillization, thickening, and organization of new products rather than to their puriform degeneration. We must wait, however, before we can justifiably apply to this disease the name of chronic rheumatic ostitis, until we know with more precision than at present what the words rheumatism and rheumatic really mean.

Symptoms.—It is of great importance that a disease, which so alters and cripples perhaps a great number of joints, and which when fully established is so little amenable to treatment, should, if possible, be recognized in its very earliest stages, and this is a matter requiring great care and experience, since at first the objective symptoms are very few. The practitioner should remember that although the disease is more usual in, it is by no means confined to, elderly persons, nor to any particular class of society; that, unless traumatic, it generally attacks several joints, but that nevertheless one joint only may be diseased long before another is implicated; that it is not necessarily preceded by attacks or by hereditary history of either gout or rheumatism, and that alteration in the form of the joint is a comparatively late symptom.

The disease, if mono-articular, is usually, if not always, preceded by local injury, varying from a bruise or sprain to a fracture or dislocation. If poly-articular, it may be preceded by acute rheumatism, exposure to cold, loss of health from mental depression or other influences, changes or defects of the menstrual function, habitual dyspepsia with acidity and other causes of lowered vitality; while again in many cases no possible preceding or accompanying abnormal condition can be detected. The first symptoms, if the malady arise from rheumatic fever or from such exposure to cold as shall produce a sudden suppression of perspiration, are much more acute than when a less potent causality exists. One or more joints, the knee, shoulder, metacarpal-phalangeal joints, most usually thus attacked, are painful, red, and swollen; there is also some pyrexia, and the highly acid urine will be loaded with lithates; the swelling, like that of rheumatism, is chiefly peri-articular. Doubtless some intra-articular effusion also occurs, but this is small in amount, except at the knee, where it may exist in considerable quantity. Such malady may be easily mistaken for a mild attack of acute rheumatism or of gout; or if it follow such attack, may be considered a relapse after some days' interval; but the temperature is much less, the skin is rather dry than bathed in acid perspiration, and the malady in this febrile form lasts but a few days; even the joint-affection may abate.

If, as is more usual, the disease commence at once in its chronic form, much obscurity will be found in its earlier stages. The patient complains of a painful stiffness, generally at first in only one joint. This may even somewhat diminish; while another joint becomes attacked, and even a third, when all the earlier troubles recur with aggravation in the one first affected. Such cases are often considered simply as "a little rheumatism." I have heard them described as creeping and senile rheumatism. One case, which

appeared to depend on sudden cessation of the lacteal secretion, was described to me as "milk rheumatism;" and more than one occurring in the hands have been sent to me as subacute gout. At this period the disease, when the limb is at rest, is but slightly painful; nor have I found that patients thus affected complain of that peculiar pain on getting warm in bed which the truly rheumatic describe; but in many cases, especially if one or more of the large joints be involved, the patient is much troubled by starting-pains. On the other hand, the painful stiffness is most marked after a night's rest, or after any continued repose, when the patient first tries to move. The skin over the affected joint is often pale, even cool; there is no high temperature even at night; perspiration is usually scant and difficult; the urine often quite normal, though sometimes too acid, and loaded with lithates.

In the very slow progress peculiar to this disease no further perceptible change may occur in the articulations save the implication of another joint or two; but the limb becomes rapidly wasted and the muscles flaccid. This occurs in the case of the knee, above rather than below the affected joint; while at the hip the emaciation invades buttock, flank, and thigh. At this period the diseased joints become somewhat limited in their movements; the hinge-joints, for instance, incapable of complete flexion or extension; the ball-and-socket joints of full rotation move especially inward, which movement is, rather than the outward, painful. It is remarkable that while normal movements become thus limited, abnormal mobility is frequently developed; up-and-down movement, for example, of the heads of femur and humerus within their cavities, sideways movement of knee or elbow. Indeed, in a few cases, lameness is due more to abnormal mobility than to fixity of the joint. About the time when limitation of normal movement commences, and always before the establishment of abnormal mobility, crepitation in the joint may be detected; crepitation, evidently bony, and due to the absorption of cartilage. This, like the stiffness, is more marked on using the limb after a period of rest; it is sometimes so harsh and loud as to be heard by a bystander. At this stage, too, occur, most markedly when the hand or foot is affected, the first slight beginnings of those deformations which afterward become such conspicuous features of the disease; the changes in the hand, to be described in the sequel, begin to be traced out so delicately that probably only a much-experienced eye can detect the deviation.

Swelling may have occurred, indeed usually does occur, previous to the changes described in the last paragraph, but the precise period of its advent is very uncertain. Mention has already been made of the fact that when preceded by acute rheumatism, or when the malady commences in an unusually acute manner, peri-articular swelling puts in an early appearance, and even synovial enlargement may likewise occur. When, however, the malady commences in a chronic form, synovial effusion is, in my experience, a later symptom, and is often absent or imperceptible until the stiffness has gone through its first stage of mere sensation, that is to say, until some real limitation of movement is discoverable. I make this statement with some little diffidence, because Professor Adams, undoubtedly one of the very greatest authorities on this subject, says, "in the early stages of this affection the principal enlargement of the joint arises from the effusion of a large quantity of fluid into the synovial sac;"[1] but the cases which he gives by no means bear out this assertion; indeed, in

[1] Loc. cit., p. 12.

several, long-continued lameness is described before any swelling is noticed. The knee may on this point be somewhat exceptional, for hydarthrosis is said sometimes to culminate in arthritis deformans. Yet such event must be rare, for I do not know of a single case of this sort of synovitis among the very many that I have treated which has so terminated. Nor, on the other hand, do I know of any case of the deforming arthritis which could be traced to a hydarthrosis, though swelling, often considerable and doubtless synovitic, has come on some months or even years after continual stiffness has been established.

Even, however, before any very distinct enlargement of the synovial membrane occurs, there will be felt, if the surgeon make pressure with his finger over the joint and move the deeper structures to and fro, a peculiar sensation comparable only to the sound of a rustle—what the French term "frou-frou;" it is like rubbing two silken surfaces together between the finger and thumb. This sort of crepitation may be very fine or coarser, and is produced by the passage of a roughened synovial membrane over other parts of the joint. It is not peculiar to the malady now under consideration, but only indicates a condition of membrane which is present in this as in certain other diseases. Of course it is only perceptible in superficial joints. I have frequently felt it in the knee, occasionally in the elbow and in fingers. Care must be taken not to mistake a similar crepitation, which is very common in the patellar and olecranon bursa, for a roughness in the joint itself. When, however, the disease has advanced to the stage in which the shape, size, and position of bones have altered, hard, irregular enlargements, Haygarth's nodosities, are easily detected, and at the same time the position of the limbs becomes changed. These changes have been in the preceding division of this chapter partly described. I will therefore only briefly consider the various postures.

Shoulder.—The head of the humerus is prominent in front, and appears also lifted, while a depression behind seems to indicate progression forward of the head and its deficiency at the back; the patient cannot lift the arm from the side nor rotate it. Great pain is produced if the surgeon execute these movements passively. Usually in this joint abnormal mobility exists; the arm can be drawn down till the head lies even below its normal level, and in tolerably advanced cases crepitus will be felt in all these movements. The shoulder is more prone than any other joint, save the hip, to traumatic causes of arthritis deformans.

Elbow.—There is no especial diagnostic position; it is one of the joints least liable to be affected alone, and by itself—a great aid to diagnosis. Synovial effusion with false bodies, and development of abnormal bursæ in the neighborhood, occur after the disease has continued some months, and I think earlier than in other joints.

Wrist and Hand.—The articulations of these members are more often attacked than any others, probably on account of their exposed condition, and the distortions produced are very characteristic of the disease. On the dorsum the wrist looks remarkably hollow from the radio-carpal articulation to the base of the metacarpus. The lower ends of the radius and ulna project considerably, the projection being most marked in the latter, which also is often much enlarged. At the metacarpo-phalangeal joints, as they become involved, singular and pathognomonic distortion is produced, the fingers being considerably adducted, so that the index forms at its radial side a salient angle with the metacarpal bone; often that finger, usually the first attacked, crosses the middle one on its dorsal aspect. The thumb, when involved, is usually strongly flexed on the metacarpo-phalangeal

joint, the phalangeal extended. The adduction of the fingers is so marked and characteristic a symptom, that it at once gives to the experienced its own solution: exceptions, however rare, occasionally occur, but nevertheless even these exceptional positions have a distinctive type, and will not be easily mistaken. Cases of mult-articular disease, which might otherwise present diagnostic difficulties, may be at once traced to their true source by a study of the wrist and hand. The various joints become after a little time enlarged, and studded with uneven, hard projections—nodosities, as Haygarth called them.

Hip.—Shortening, partially real but chiefly apparent;[1] limb usually rotated outward, divergent from its fellow; nates of affected side flattened and flaccid; considerable lameness. Voluntary flexion and rotation are very limited, the latter more especially in the inward direction. If the surgeon cause such movements, considerable pain is produced, and crepi-

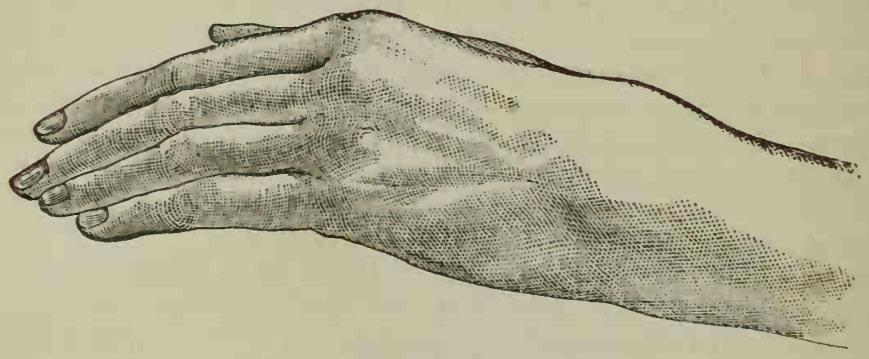

Fig. 41.—Early arthritis deformans.

tation is nearly always perceptible. Some abnormal mobility usually exists. The thigh can be drawn downward, and on cessation of traction it will be seen to rise again. The patient experiences great pain on walking, if he throw his weight on the affected limb, but no pain on pushing the heel up, or thrusting the trochanter toward the joint, which differentiates the disease from ordinary coxitis.

It is to be remembered that of all joints the hip is most usually alone affected, indeed the term *malum coxæ senile* originates from that peculiarity. When mono-articular at the hip, the affection is often traumatic. The eversion of the limb, the shortening and the crepitus, are often a cause of embarrassment in diagnosis. If a person, of whom the surgeon previously knows nothing, but who has for some time suffered from arthritis deformans, come to him after a fall or severe blow on the hip, he will probably be at first led to diagnose intra-capsular fracture; and even when previous history arouses a suspicion of other disease, he may find it difficult to assure himself that fracture does not also exist; for the two are by no means incompatible.

Knee.—Abduction and outward rotation of the tibia, increase in breadth of the patella, which also tends to lie outside its normal position; rapid wasting of thigh, and, less rapid or complete, of leg. Enlargement from synovial effusion is either earlier at this joint, or, on account of its superficial position, is more readily detected. After the subsidence of the secretion, sometimes before its advent, the synovial rubbing or rustle can be

[1] For the full exposition of these real and apparent conditions, see Chapter on Hip Disease.

easily felt, and loose bodies in the joint detected. Earlier than at other joints, except the fingers, can osteophytes, or at least rough bony excrescences around the joint, be clearly felt. It would be well to state that cases of increased synovial effusion with roughened membrane, even with one or two false bodies, are not to be ascribed to the disease in question, unless the above-described mal-postures of tibia and patella can be verified; unless abundant growth of osteophytes can be distinguished; or, again, unless several other joints are thus arthritic.

Ankle and Foot.—Of all the joints in the lower extremity the metacarpo-phalangeal joint of the great toe is most often affected; then the medio-tarsal joint (generally with some other tarsal or tarso-metatarsal articulation), and least often the ankle. But it is to be noted that when the disease has invaded one of these small joints, it spreads pretty rapidly to others. The hallux is thrown outward, so that the head of the metatarsal bone becomes salient and nodose. But this position is so constantly a mere effect of wearing pointed shoes, that such posture is not, as in the hand, diagnostic; even some grating in the joint may be merely a local effect of bad shoeing. Other joints of the same or opposite foot, and of the hands, must be studied. At the medio-tarsal joint the disease produces an enlargement which runs round the whole waist of the foot, and is especially marked on the inner side by projection of the head of the astragalus and scaphoid—after the manner of flat foot. The enlargement of the whole circumference of the tarsus—the fact that the outer border of the foot, though it loses some of its convexity, is not concave, as in the slighter forms of valgus—will afford sufficient points for diagnosis. Moreover, some effusion into the sheaths of the neighboring tendons usually takes place in arthritis of the tarsus. The ankle is rarely the seat of this disease, and still more rarely is alone affected. The chief symptoms are an appearance of width between the malleoli, while each malleolus in itself is increased in breadth from before backward. Tendinous sheaths are enlarged. The stiffness produced by ankle-joint arthritis, especially if combined with tarsal disease, causes a heavy, clumsy, and noisy gait; also, to avoid as much as possible movement of those articulations, the patient in walking everts the foot considerably; when, however, he is placed at rest with the legs horizontal, the eversion vanishes. This is a very characteristic symptom.

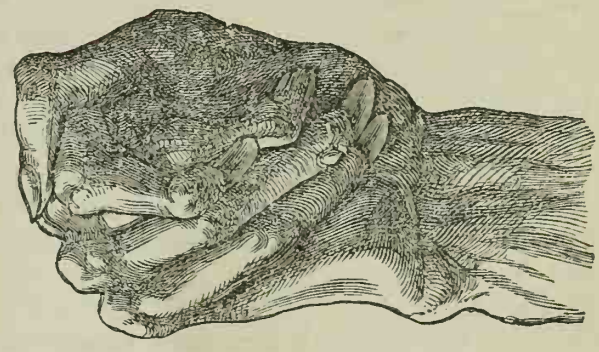

Fig. 42.—Arthritis deformans (after Canton).

In the above descriptions of the malady I have, as far as possible, confined myself to those appearances which are the first, or at least very early, objective symptoms. When the disease is more fully advanced, when the joints are not only crippled but deformed, often grotesquely by outgrowths and nodosities, no tyro would hesitate in forming a diagnosis. If we take, for instance, the hand here depicted, an exact counterpart of which came under my notice in an old lady during October, 1876, or if we imagine the gnarled, swollen joint produced by such an altered skeleton as that depicted at p. 256, it seems unnecessary further to describe the local characteristics of this disease. The gradual increase of stiffness, the invasion of a greater

number of joints, the almost entire helplessness which such condition in the end produces, furnishes a distressing and a hopeless picture. More especially painful is the condition when, among others, the temporo-maxillary joint is involved, rendering mastication a difficult and distressing process.

Yet in a certain number of such cases the health is frequently remarkably good. Sometimes it appears as though the malady arose from superabundance of functional and digestive powers; the appetite is perfect, digestion easy and even rapid, but with occasional acidity; bowels rather costive, with scybalous motions; sleep sound; complexion fresh and rosy; skin soft and moist. We may find that in some of these functions a little superabundance prevails—somewhat too much of food and too little work—such cases seem to have been those which chiefly came under the observation of Sir B. Brodie. We may discover, on strict inquiry, that there is some acidity and flatulence, a great tendency to sleep after meals, a loose condition both of muscles and skin, a tendency to the accumulation of soft fat and a greasy, unctuous condition of surface. Such comfortable functional performance may continue to the very end of the disease, even when the patient is set fast and incapable of moving any joint in the body. Some years ago I occasionally was called to see a lady, the joints of whose lower jaw, one shoulder, and perhaps one or two of the vertebral articulations, were the only ones unaffected; the hips and knees were perfectly fixed. In one arm and hand there was sufficient movement for her to feed herself; she was every morning lifted out of bed into a chair, every evening back again to bed, without altering the angle of the thigh and body, or of the knees. Yet she enjoyed, so far as the performance of all bodily functions, except movement, is concerned, perfectly good health, with the exception of slight acidity after food. With the exception of her joint-troubles and occasional indigestion, I do not think she had a day's illness for the last ten years of her life. She died simply of old age, at the age of eighty-one.

The more usual systemic condition, however, is that of debility, to which some external depressant has been superadded; exposure to cold and damp, insufficient and ill-adapted food, weakened powers of digestion, derangement of menstrual function, or even mental disquietude and sorrow. In such instances the marks of a lowered health will be found; the acidity which is usually present will be traceable to an atonic rather than to an over-fed state of stomach. The urine, generally much too acid, will be found loaded with lithates—alternating occasionally with a neutral phosphatic condition. The skin is dry and harsh; feet and hands liable to be cold. The patient at first wastes rapidly up to a certain point, and does not recover the lost flesh. Such instances are of course more common among the poorer classes, but occasionally among the well-to-do. Whatever be the bodily condition, even in the very worst cases, it never appears commensurate with the amount of local mischief.

Treatment.—In proposing a name new in England for this disease I am not actuated by any love of mere change, but by a desire that names such as rheumatic gout and rheumatoid arthritis may not, by influencing our views as to the nature of the disease, involve any corresponding ideas of treatment; for neither by such regimen as would benefit gout, nor by many of the remedies we should employ in rheumatism, can any good be effected in arthritis deformans.

When the malady commences in an acute or subacute form, especially in any febrile action, more particularly if the urine be too acid and contain

lithates, we may advantageously employ febrifuge, but not debilitating remedies. The skin being hot and dry, or simply dry, would indicate one of the salts of ammonia—the effervescing citrate in the formula already given, the citrate of potash or the spirit of nitrous ether. Indeed, all this class of remedies will be found useful in restraining the pyrexia, and alleviating the acidity both of the primæ viæ and of the urine. An aperient sufficient to produce a free, but not a large action of the bowel, should also be administered, but violent action—purging—should be avoided.

Of special remedies in this phase of disease I have but to mention a few. Colchicum is, I believe, injurious, save a single dose of the extract given as an alterative, or cholagogue, with the cathartic. Iodine should be avoided till the fever is past. Salicine does not appear to me to exert any marked influence in this disease; it neither alleviates pain nor lowers the temperature, as it does in the much more febrile and painful condition, namely, acute gout. I speak, however, from a somewhat complex experience, and since the time when that drug came into vogue I have seen but few cases in their simplicity, and so unsophisticated by previous drugs as to be fit subjects for deduction. Nor is there any great need of a special remedy. This particular phase of the disease may be in a few days subdued by such medicines as above indicated, but more by rest in bed. By rest, I mean not merely lying down, but almost absolute quietude of the affected joints; even nicely adapted splints, pillows under the knees, slinging one or the other leg, etc., may be employed to produce such immobility of the inflamed parts as may be obtainable without absolute coercion. We shall see by-and-by that in further advanced stages of the malady rest is not so desirable, but in this, the more acute phase, it very much checks the advent of further symptoms, and may postpone them indefinitely. Another advantage of confinement to bed, while pyrexia continues, is the preservation of an even temperature, a most important part of the treatment, especially if sudorifics be exhibited.

To any joint more especially painful, particularly if it be hot with swelling of peri-articular tissue or of sheaths passing over it, from one to four leeches, according to its size, may be applied; but such treatment must not be repeated often enough to debilitate. Hot water, or, still better, hot solution of bicarbonate of potash, about ½ drachm to the ounce, may be used as a bath for fifteen minutes; or flannel soaked in a much weaker solution may be kept under thin mackintosh to the part. To this a little hydrocyanic acid, about twenty minims to the ounce, may be added, and, what has often appeared to me efficacious in relieving pain, as much camphor as can be dissolved in a drachm of spirit. Belladonna also may be advantageously used in the same way. Conium, too, and opium may be employed; but in all these I consider the bicarbonate of potash as the most valuable ingredient, as having a real effect on the morbid condition; the others act only by subduing pain and irritation.

A light but fairly nutritious diet should be given, and certain persons whose free digestion and large appetite (see p. 264) cause them to consume much meat two or even three times a day, must undergo some modification of habit; but this must be effected with caution; even though the patient seem in strong health, the correlations of this disease with debility must not be overlooked. Unless the fever run unusually high, a little claret, or, what is better, unless it disagree with the stomach, a little old, pure whiskey, in preference with hot water, or with potash or soda-water.

When this acute phase has passed, the disease will fall under the same mode of treatment as though it had been from the first chronic; and in

either case we have to consider two somewhat different conditions: that which performs the usual functions of life easily and which appears well nourished, and that which is marked by a spare, ill-nourished and depressed system. Nevertheless, in both cases the malady is essentially one of debility, and the desirable varieties of treatment relate to different proportions rather than to different kinds of remedy. All medicines having a tendency to depress the system must either be entirely avoided or used with the utmost caution, and although the action of the bowels generally requires some regulation, drastic purges are forbidden. The perchloride of mercury in small doses, and not long continued, has, in my hands, proved beneficial; it may be combined with iodine or with other drugs, as we shall shortly see. Iodine, either by itself or with iron, is very valuable (Formula I.). Guaiacum is more especially useful when the skin of the hands and feet and of the affected joints is cold and clammy—combination with ammonia appears to increase its value.

As already stated, I consider this malady one of debility, hence any form of tonic is useful. Iron, either combined with iodine, or given as the perchloride, with the same salt of mercury—quinine, strychnia, are all useful. Arsenic, too, is occasionally followed by improvement; but I cannot extol the remedy to the same extent as did the late Dr. Fuller; indeed, its action requires close watching, lest it disorder the digestion and produce liver troubles. With these remedies a light but nutritious diet should be ordered, and a certain amount of stimulus may be administered.

Among the most valuable remedies, as Dr. Haygarth long ago pointed out, are baths. If circumstances do not permit the use of natural hot baths, even simple hot water, or hot water with carbonate of soda or potash are very useful; they appear to act by recalling the function of the skin, and in some unexplained way check the progress of disease. More valuable by far are certain natural hot waters; those of Buxton, Harrogate, Bath, and Tunbridge, in England, are most commendable. On the Continent are many—Vichy, Carlsbad, Aix, Barréges.

The use of mineral waters internally is efficacious, and my experience points more particularly to the Woodhall Spa Bromo-iodide springs. I have seen very beneficial results follow their use, more especially, of course, in the earlier phases of the disease. One case, in which I was consulted by Dr. Hammond of Preston, the greatest benefit was obtained; the patient, who for some months had only gone out in a bath-chair, being after some time able to walk fairly well; the already adducted fingers resuming their normal position and the nodosities greatly diminishing. I must, however, in justice, say that although other cases have profited from these waters prescribed by me, none other have obtained such very strongly marked benefit.

I cannot say that I have found any benefit to accrue from blisters, iodine, or other derivative—but have thought that nightly compresses of solution of potash, or still better, of the Kreuznach Mutterlauge, has had a good effect, certainly relieving pain. The patient in this chronic stage should be encouraged to take a certain amount of exercise—motion retards the laming and stiffening progress of the disease.

CHAPTER XIII.

INFLAMMATION AND DEGENERATION OF CARTILAGES.

Most works on diseases of the joints contain a part devoted to maladies which have their especial seat in the cartilages; and yet nothing can be more sure than that, of all the joint diseases which fall under the surgeon's notice, not one originates in the cartilage. It has been seen, that an inflammatory action, commencing in the synovial membrane or in the bone, will spread to the cartilage and set up an ulceration of that structure; it is also well known that in the dead-house and dissecting-room we frequently find breaches of continuity and tissue-changes in various articular cartilages which were accompanied by no symptom during life. The joints in which such conditions are found have been perfectly free from any pain or any diminution of mobility, at most a crepitating movement, and the neighboring tissues have been perfectly untouched by any disease whatever. Thus we come to the inevitable conclusion, that disease confined to the cartilage gives rise to no symptoms; and we must ask whether disease, which has commenced elsewhere and passes to the cartilage, may give any sign whereby we can tell whether or no the cartilage be diseased? To answer this question fully it is necessary to enter somewhat deeply into the physiology and pathology of cartilage; but as the subject has occupied some attention in each division of this work, it will be only necessary to revert to the points already treated, and the present chapter will rather be a *résumé* than a full exposition of the subject.

The questions resolve themselves into these: Are there different sorts of ulceration of cartilage; one accompanied, the other unaccompanied, by any symptom? If so, are either or both these ulcerations produced by some action of the tissue itself, or of some other tissue, absorbing the cartilage as a passive material?

Sir B. Brodie has, throughout all the editions of his work on Diseases of the Joints, adhered to his original view of active changes in the cartilages; in his earlier papers he ascribed these to the intervention of vessels; and he has even in his fifth edition some difficulty in getting rid of the idea, since he affirms that "in persons who have not yet attained their full growth, vessels penetrate into the articular cartilage." Mr. Aston Key, however, in 1833, saw some reason to doubt the possibility of any vital actions in cartilage, and attributed their absorption entirely to the "villous processes developed on the synovial membrane during inflammation of that structure." Sir B. Brodie, nevertheless, adhered to his original idea. In 1843 M. Richet,[1] of the Hôpital Bon-Secours, added his testimony to the idea of cartilage being a dead, an almost inorganic, material. Dr. Ecker,[2]

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[1] Richet: Sur les tumeurs blanches. Annales de chirurgie.

[2] Ueber Abnützung und Zerstörung der Gelenkknorpel. Archiv für physiologische Heilkunde, vol. ii., p. 235.

in 1844, published the first observations upon the actions and conditions of cartilage-cells in disease. One of Mr. Goodsir's "Pathological and Surgical Observations," in 1845, also mentioned the growth and increase in the number and size of the cells. In 1848 Dr. Redfern published a series of careful and minute observations "On the Abnormal Nutrition of Articular Cartilages," carrying further the researches of Ecker and Goodsir, and disclosing many details which those authors had not mentioned.[1] Yet the idea that cartilage is truly a living structure, capable of vital action, penetrated so slowly, that in 1853 M. Richet, in a paper on white swelling,[2] insisted upon the inactivity of cartilage, and was at pains to prove that it is incapable of any independent action, saying, although he refers to Dr. Redfern's paper, "that the only direct manner of proving that cartilages are susceptible of inflammation would be to demonstrate vessels in their substance itself." Mr. Birkett[3] censures the use of the word ulceration, and desires to substitute "disintegration."

Mr. Bryant,[4] following too implicitly in this path, ascribed all the diseases of cartilage to atrophy; degeneration and hypertrophy being only mentioned in order to throw doubt on the possibility of their occurrence.

I believe myself to have been the first to have pointed out, that those diseases of cartilage which accompany the inflammation of other tissues in the joint are, in reality, also inflammation.[5] The whole view of the subject, and the arguments which irresistibly lead to this conclusion, have been already detailed in several preceding chapters. Histologically, cartilage belongs to the connective tissues, and we have seen abundant evidence of the fact that their inflammation is accompanied by, or to a certain extent consists in, a rapid multiplication of the cells which form an essential part of their structure. Previous to and in 1860 I pointed out in the first edition of this work, that the cell-proliferation which causes those forms of cartilage-disintegration that accompany inflammatory joint disease, is itself inflammation; that, in fact, the cartilages are, like the other articular structures, areolar,[6] ligamentous, and osseous,[7] capable of inflammation. Nor do I hold that the discovery of emigrated leucocytes vitiates, though it may to a certain small extent modify this doctrine; for it must be remembered that both Von Recklinghausen and Cohnheim never pushed their views to the length which some of their followers have reached, in ascribing all inflammatory phenomena to the influence of "Wanderzellen." There are three roads by which such bodies could penetrate the cartilage: through the articular lamella, by the margin of the synovial membrane (structurally continuous with the cartilage), and by first mixing with the synovia. Of these roads the first is problematical. The second route is certainly open; and I have seen, when the synovial membrane has been inflamed, bodies I conceive to be more or less altered leucocytes, infesting this border and slowly undergoing changes into fibre-cells. The third road is also feasible; but I have always failed to find such bodies penetrating beyond the mere surface of the cartilage, unless where a false membrane or concretion had

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[1] See my paper On the relation between Synovitis and Ulceration of Articular Cartilages, Edinburgh Medical Journal, February, 1860.

[2] Mémoires de l'Académie Impériale, tome xvii., 1853.

[3] Guy's Hospital Reports, second series, vol. vi., p. 237.

[4] Diseases and Injuries of the Joints.

[5] See my paper On the Nutrition and Inflammation of Articular Cartilages, in Med.-Chir. Review, October, 1859.

[6] See my paper On Granulation, Beale's Archives, vol. ii., No. 5.

[7] See my paper On Osteitis, in Med.-Chir. Review, April, 1860; and Chap. XI.

adhered or unless inflammatory pus (not mere surface pus, see p. 29) was in the cavity. In such circumstances the cartilage is milky; its surface is soft, accepts readily and retains the impress of the nail, and lies loose, like a film partially detached, upon the deeper parts. Again, when breach of surface has taken place, leucocytes may perhaps readily find their way into the ulcer; some of the smaller cell-forms are possibly emigration-bodies. But of this I am quite sure, that the chief work of cartilage-ulceration is effected not by Wanderzellen, but by the proliferation of cells belonging to the cartilage itself, which eat up or absorb the hyaline structure as nutriment for their hyperplasia.

Inflammatory diseases of the cartilage only occur when surrounding structures are inflamed. The reason that inflammation of cartilage does not form a primary joint disease is to be found in the insusceptibility of that material to mechanical or other irritation—an insusceptibility which constitutes its great value—and also in its sluggishness of action. Hence, many injuries or irritations may be insufficient to produce primary inflammation of cartilage, yet be amply intense enough to set up synovitis, which may secondarily cause those structures to become inflamed. Or, again, an injury may be sufficient to cause primary cartilaginous inflammation; but it must, at the same time, of necessity be sufficient to produce either synovitis or ostitis, or both, and the actions of either tissue being so much more rapid than that of cartilage, we find these inflammations preceding the cartilaginous disease. The question is not whether cartilage be susceptible of primary inflammation, but whether, under the circumstances in which it is placed, such disease ever presents itself to the practical surgeon. It cannot, probably, be directly proved that inflammatory ulcers of cartilages never take place unless some other part of the joint-apparatus be also diseased; but we know that the symptoms of joint-inflammation become greatly aggravated when the cartilages begin to participate, hence this inflammation is a painful and wearing disease; but we never come across such symptoms unaccompanied, or rather unpreceded, by inflammation of other joint-structures.

The inflammation may be, as we have already said, acute or chronic. It consists essentially in the rapid generation of cells from those primarily existing in the structure. When this generation is very quick, it absorbs the hyaline substance rapidly, and an ulcer, with clean-cut edges, is produced; when the action is chronic, the hyaline structure is first converted into fibres, which render the edge and bottom of the ulcer rough and uneven. The changes which the cells undergo have been described by Mr. Redfern, who has not, however, separated degenerative from inflammatory diseases. The first appearance in microscopic examination of the inflamed tissue, is an increase in the number of nuclei contained in the cells, and in the number of cells in the corpuscle—hence the increase of these bodies in size. In the most acute form of the disease the corpuscles are converted into large conglomerations of cells and nuclei, lying very close together, many of the cells containing two or more nuclei. In the most acute forms this growth is so rapid that it devours entirely the intercellular material, and thus an ulcer is left, with perfectly clean, smooth edges.

The chronic inflammation differs from this by the more plastic character of its results. A large number of the cells formed do not simply become pus-cells, but, being produced by a slower action, have a more persistent character and a more perfect life. They change into fusiform and into fibre-cells, and thus the fibrillation of cartilage is, in such instances, not a mere mechanical splitting of hyaline structure, but is also, in part, an ac-

tual production of fibres from cells—the action is almost identical with the physiological changes which in the embryo convert what formerly was cartilage into synovial tissues; but in the circumstances now under review the process is morbid, and the material formed is a coarse sort of areolar tissue, or a fibro-cartilage (see Figs. 7 and 8). Much of this formation is not doomed to be persistent, but some of it goes on developing further, while the action increases in area, and at last some of it comes in contact with granulation from the synovial membrane, or from the bone (the articular lamella having in places disappeared). The two parts thus in contact are engaged in identical processes, the transformation of fusiform cells into cell-fibres and areolar tissue; they therefore unite, or rather grow together, so intimately that it is impossible to find the boundary between the two structures (p. 101).[1] When a disease stops at this stage, we may find, upon subsequent examination, a partial and false anchylosis; that is, there will be anchylosis in some parts, sound cartilage in others. Sometimes chronic ulcers, if small, leave behind simply a cicatrix, like a scar in any other tissue. These marks in cartilage are always the result of a very slow inflammation; a more rapid action, instead of converting the cells, their progeny and the hyaline substance into fibre- and areolar-cells, causes them to disappear, leaving a breach of surface which is not filled up by any scar.

When the primary attack is an ostitis, the cartilage undergoes the process both of degeneration and inflammation. In articular diseases thus commencing it is to be remembered, that generally only one of the bones forming the joints is primarily affected; moreover, it is seldom so extensively diseased that the whole surface, whereon the cartilage rests, undergoes morbid action at the same time. Now, the first effect of an ostitis upon the cartilage is, in most instances, a cessation of its supply of nutriment; hence detachment, with its articular lamella, from the inflamed portion of the bone (see Fig. 47). Around the spots where such degeneration takes place, the cartilage will not thus be killed, as it were, by starvation, but either remains normal or will become inflamed and ulcerated. The cartilages covering the bone, which still remains normal, will, when the other joint-textures become inflamed, participate in the inflammation, just as they do in a synovitis. Thus, in articular diseases, commencing in one of the bones, there are two sorts of action going on in the cartilages—inflammation and exfoliation. Sometimes even in cases originally synovitic portions of cartilage may be thus shed. This occurs when the articular lamella has been in some points perforated, whence cancellar hyperæmia has spread, and undermined a portion of cartilage previously healthy. The cartilage which has suffered degeneration, and which lies over the focus of inflammation, is detached with the articular lamella by the ostitis itself, and is frequently pushed by a collection of pus, or a growth of granulations, into the joint-cavity, in which it is found lying loose and fatty, its formerly attached surface feeling gritty like sand-paper, from the adherence of the more or less broken-down articular lamella.

But ulcerations of, *i.e.*, breaches of continuity in, cartilage occur when the parts around are perfectly healthy. The existence of these lesions is not suspected during life; they are found in the dead subject, whose articular functions had been perfect. Such ulcers look to the naked eye more fibrous, rough, and are generally softer than those already described; sometimes the cartilage is converted into a set of parallel fibres, close to-

[1] It was this condition which led Mr. Aston Key to conclude on the destruction of cartilages by growths from synovial membrane.

gether, and standing from the bone surface as the pile of velvet from the woof; and often that part of the cartilage is yellow. If sections of this material be examined microscopically, the corpuscles will be found increased in size, and the contained cells are also larger; but they are not increased in number. Those corpuscles which contained two, three, or four cells near the attached surface, still continue, on approaching the outer edge, to possess only an equal number of cells. The nuclei do not multiply; on the other hand, they become obscured by an accumulation of minute globules of oil around them, between the cell-wall and the nucleus; in a further advanced stage, and nearer the free surface, the corpuscle itself gets filled with the oil, which lies around the cells, while the hyaline substance is crowded with and rendered opaque with oil-globules. The fibrification of the hyaline portion commences by the appearance of thin, faint striæ; in some instances there may be seen between these a row of oil-globules, and the striæ become numerous and more open, until the substance is split into fibres.

This fatty degeneration is a passive disease, and consists simply in the fact that the cartilage-cells have imbibed material which unfits them for their nutrient function. There is also another form of cartilaginous degeneration—the granular; it has the same effect upon the hyaline substance of splitting it into fibres. Microscopic examination shows that the corpuscles, when thus affected, become minutely spotted with a substance more opaque than the surrounding material; they, at the same time, become enlarged, but very shortly afterward shrivel, each corpuscle forming a thin transverse scale long before it comes to the free edge; these lines, or scales, appear divided, as though by the old cell-walls, but the usual aspect of the cell and corpuscle is lost.

I consider that the fatty degeneration of cartilage is similar to that degenerate state of the cornea which Mr. Canton has shown to be the essence of *arcus senilis*, while the granular is comparable to the atheromatous condition of arteries.

In neither of these cases do the nuclei and cells multiply; they simply absorb a morbid material and lose their nutrient power, hence the action in question is a passive one—a mere degeneration. The function of articular cartilage is so passive, and is spread over so large a surface, that we have no means of ascertaining when these degenerative diseases are taking place over a small extent of the tissue; and, being but passive changes, they are not accompanied by any hyperæmia, nor by any pain. The ulceration, then, of cartilages may be divided into inflammatory and degenerative, and these latter again must be subdivided. The changes whereon degeneration depends are situated in the cell, and therefore we must class them according to conditions of that body; hence the term fibrous degeneration is false, and the more so as fibrification of the hyaline substance accompanies every morbid change of cartilage. We may therefore divide degenerative diseases into fatty and granular, and as these are mere passive changes, occurring in a structure without sensibility, so they do not give rise to any symptoms.

Another form of malady resulting from deposit in the cartilage of a morbid material, viz., urate of soda, appears scarcely to belong to the degenerative class, although it ends in degeneration. The chalk is deposited actually in the cartilage, *i.e.*, in the hyaline substance around the corpuscle; but the extreme opacity of the material renders it extremely difficult to trace the connection between it and the containing tissue. It soon splits the cartilage and lies among the fibres, which, if the deposit be in any

great quantity, almost disappear, and the tissue is converted into a layer of chalk-stone, held together by scattered fibres. Sometimes this deposit, or other cause, sets up inflammation, which causes the cartilage to yield more completely, and the urate is thrown off into the joint, sometimes *en masse*, sometimes mingled with the pus, or synovia, to which, being held in suspension, it gives a peculiar milky color and gritty feel.

A peculiar change of structure has been much studied by my friend Dr. Reyher of Dorpat. I regretfully refer to his admirable work[1] for details, being obliged by the limits of my space to renounce quoting his conclusions fully. He experimented by placing one limb of a number of dogs in plaster-of-Paris bandages for a variable number of weeks; the result being that those parts of the cartilage which were out of contact underwent gradual transformation into areolar tissue (Bindegewebe), with development of "epithelioid" cells. This transformation is the same as that which I long ago described as taking place under the synovial processes, and is never combined with either fatty, granular, or caseous degeneration.

At p. 182 I mentioned the singular fact that pieces of articular cartilage may be chipped out from the rest and lie loose in the articular cavity, forming one species of loose body. Such rending away of a fragment from a previously healthy cartilage is evidently impossible. The process whereby the detachment is determined was described by Mr. Teale[2] as an effect of traumatism, producing a necrosis of the cartilage with the underlying layer of bone. Sir James Paget's subsequent nomenclature, "quiet necrosis," marks its non-inflammatory character.

The growth of a cartilaginous tumor from healthy cartilage, an ecchondrosis (by this term an analogy with exostosis is indicated), is a very rare event, concerning whose occurrence I am sceptical.

In the examination of certain joint diseases, viz., chronic rheumatic synovitis and arthritis deformans, the cartilages will be found to have lost their opalescent appearance, to have become abnormally transparent, of a pinkish brown color, and to be very much thinner than natural. They have in such cases an even surface, except rarely in a few small spots where they may be ulcerated, the ulcers smooth or nearly smooth; very frequently a piece of eburnated bone will be found on the same plane as the cartilaginous surface. I believe this condition to be a slow form of inflammation, tending, like other processes of rheumatic origin, to the completion of all the parts involved. The attenuation, I believe, takes place, not from the free but from the attached surface, by encroachment of bone upon the cartilage, and this opinion is much strengthened by the fact, that there seems to be a solid case of bone thicker than usual between the osseous cancelli and the cartilage; moreover, the articular lamella gradually assumes more and more the structure of ordinary bone.

It is certain that cartilage being endowed with nutrient power may be capable of both hypertrophy and atrophy, but practically we do not come across such diseases. In young subjects the cartilage may be found excessively thick, but I have always attributed this to delayed ossification of the epiphysis. In adults the cartilages may be found slightly thickened, but they are then likewise sodden and soft, and their increase probably results

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[1] Ueber die Veränderungen der Gelenke bei dauernder Ruhe. Zeitschrift der Chirurgie, iii., p. 189.

[2] Medico-Chirurg. Transactions, vol. xxxix.

from mere passive imbibition of fluid. Still, as above stated, the possibility of simple hypertrophy cannot be denied to a tissue capable of both nutrition and inflammation.

Atrophy of cartilage, as described by some authors, that is, considerable decrease in its normal thickness, is due, I believe, to encroachment of bone upon its deep surface, as just described. The granular and fatty degeneration is a result of ill-nutrition, and the only undoubted form of an atrophic condition.

CHAPTER XIV.

HIP-JOINT DISEASE.

Pathology.—It may not be in accordance with strict logical arrangement that one particular joint should be singled out for a special chapter ; but it will, I believe, tend to make this book more valuable, if the diagnostic signs of hip-disease be separately discussed. By means of this articulation, the strongest limb in the body is fastened to the trunk itself ; it lies so deep, that at no part can we put our fingers immediately upon or over the synovial membrane, as in every other important joint ; and we cannot, therefore, detect fluctuation, changes of shape, or of size, with anything like the readiness with which we can find the like alterations in other and more superficial joints. For example, an inflammatory affection of the knee is often revealed by the swelling, before any pain shall have called the patient's attention to the part ; the changes of shape, size, etc., are perfectly distinguishable, and the failure of mobility is easily detected. But the round, massive form of the parts about the hip, the difficulty, or rather impossibility, of fixing the pelvis with the hand, the projection of the trochanter, and the bend of the neck of the femur, rendering the true radius of motion very short, the mode in which the whole head of the bone is impacted in the socket, and many other circumstances, throw great obstacles in the way of a diagnosis, concerning merely the presence or absence of disease at this articulation.

The rarity of opportunities for obtaining specimens of recent disease produces great diversity of view as to the particular structure in which the malady may begin. This commencement has been accredited to the Haversian gland, to the ligamentum teres, and to the cartilages as well as to the synovial membrane and bone. The symptoms, viz., lengthening, shortening, pain at the knee, etc., have been attributed to almost as many causes as there have been authors to assign them, and thus the whole subject is still greatly involved, and, in not a few points, obscure.

First, as to the structure in which disease of the hip-joint may commence. There can be no doubt that it may begin either in the synovial membrane or in the bone, like other joint diseases ; there is neither any proof nor any reason to suppose that, unlike other joint diseases, it may start from the ligaments or cartilages. Who ever heard of a knee-joint disease beginning in the crucial ligaments ? Who has not heard of a hip-disease beginning in the round one ? The reason of this preference for, I had almost said superstition about, the ligamentum teres lies in the fact that it carries the blood-vessels, which convey nutriment to the epiphysal head ; therefore an epiphysitis, a very common event, must of necessity produce hyperæmia of the vessels in the ligament, which is soon followed by inflammation and softening of the whole structure. One must not therefore accept, as an instance of primary affection of this ligament, any case of inflammation or ulceration, unless section of the bone have been made and that structure have been found free of disease ; especially as in no case of

ostitis about the epiphysis have I ever found the round ligament other than entirely absorbed, thinned and inflamed, or ulcerated and hanging in shreds.[1] Thus we come back to the two tissues—synovial membrane and bone—whose morbid affections are, as we have seen, the cause of all joint disease. The synovial membrane, however, of the hip, unlike that of the knee, is particularly well protected against external violence and outward cold; the bones are, on the contrary, in a condition peculiarly apt to pass from health to disease.

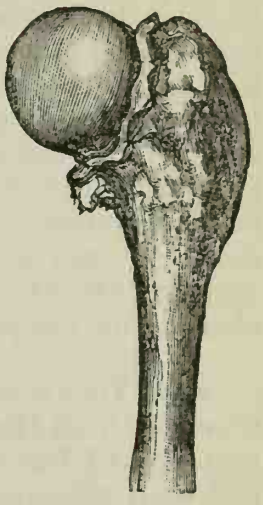

FIG. 43.—Upper end of femur; still-born child.

The anatomy of this articulation in early life is somewhat peculiar. The acetabulum is not, as in adults, hollowed out of a single bone, but is divided into three parts by as many lines of cartilage, which, radiating from near the centre of the cavity, like the limbs of a letter Y, give that name to the junction. Along both margins of each line enlargement by growth takes place; therefore, in six parts of the cavity *within the synovial sac*, great plastic activity, together with hyperæmia, is continually going on.

The upper extremity of the femur of the newly born babe is very different in form from the fully developed bone; the head is large in proportion to the trochanters and shaft, the neck being quite undeveloped, so that the former seems sessile on the latter portion. Some time during the first year of life a bony nucleus appears in the upper part of the head, and during the fourth year an apophysal centre for the great trochanter. The small trochanter, whose ossification is much later, need not interest us here; but the peculiarities of relationship between the epiphysal head and the rest of the bone are very important. The subjoined cut, representing the section of a bone before union of its various parts has taken place, shows that the epiphysis does not form by any means the whole upper extremity of the femur, but that all the lower and outer portion of the head and all the neck of the bone are derived from the diaphysal centre. Now, if we compare the upper femoral end of a newly born child (Fig. 43) with that of a boy in his sixteenth year (Fig. 44), if we consider the place where the synovial membrane (represented by a dotted line) is attached, we see at once that the whole growth of the head takes place within the joint-cavity; and not only so, but that all the neck—viz., more than an inch in length of a large bone—is formed entirely within the synovial membrane, which, as we see, encloses not merely the epiphysis, but also a large portion of the rapidly growing diaphysis.

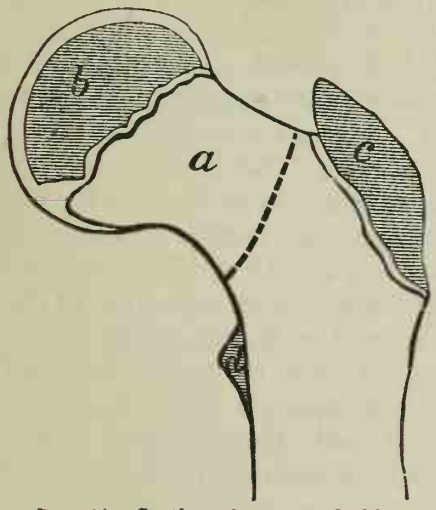

FIG. 44.—Section of upper end of femur; boy aged sixteen. The diaphysis is left light; the additions are in tone. *a*, shaft, neck, and diaphysal head. *b*, epiphysal head. *c*, *d*, large and small trochanters. The dotted line marks the synovial insertion (diagrammatic).

[1] Mr. Aston Key, Med.-Chir. Trans., vol. xvii., p. 230, gave the weight of his authority to this view. Mr. Holmes, Surgical Diseases of Childhood, p. 253, adheres, somewhat dubitating, to the same idea. The case he quotes and the plate do not, for reasons given in the text, support him. The case related by Martin and Collineau, De la Coxalgie, pp. 142, 143, is, to my mind, a typical example of osteo-myelitis.

Let us contrast this condition with other large joints, as the knee. Here both the epiphysal junctions, save the anterior extremity of the femoral one, lie outside the joint; we see at once that hyperæmia, even disease about these parts, may persist for a long time without affecting the joint itself, because there is no immediate connection or communication between the one and the other. At the shoulder the inner portion of the epiphysal junction lies within the synovial sac; but, in the absence of a real neck to the humerus, how weak in comparison to that at the femur is the formative energy! At the hip, both pelvic and femoral growth lie entirely within the joint-sac; that growth is most rapid, and any over-action, any inflammatory or other morbid condition, at this place is at once reflected as a joint disease. To my mind there is no doubt whatever that nearly all cases of chronic infantile hip-joint disease originate in the bone, and more especially about the pelvic or epiphysal junctions.

Case LXVII.—John C., aged five, was admitted under my care into Charing Cross Hospital, April 19, 1879, with hip disease. It appeared that limping had first been observed three weeks before that date, but the child had been ailing and complaining of pain about the limb a week or ten days previously. The child appeared very ill, weak and apathetic, and fatigued in the daytime, wakeful and starting at night. It was very difficult to get the child to walk even a step; he would not put weight on the limb.

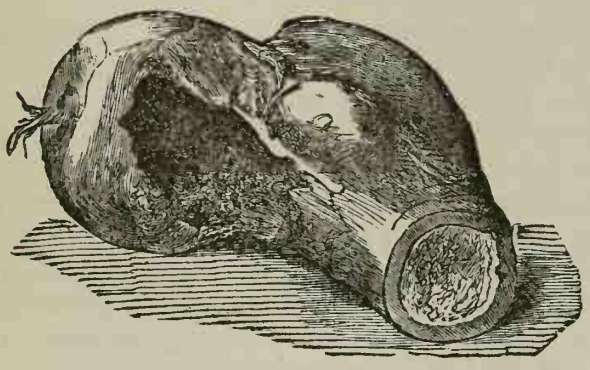

Fig. 45.—Femoral hip disease.

On the 4th of May cerebral symptoms set in, and on the 10th he died of tubercular meningitis, as the symptoms and post-mortem appearances showed. Fig. 45 is a representation of parts at the hip, in the position necessary to show the osseous caries; what remains of the round ligament can barely be seen; it was very thin, soft and shreddy; red, and infiltrated with a blood-stained serum. The epiphysal and diaphysal head of the bone, with a portion of the neck, was at its lower part quite carious; the excavation shown in the figure was, when fresh, filled up with thick pus, mingled with bony detritus and soft granulation-tissue. The cartilage was intact, though thinned, except around the carious cavity, where it had in great part disappeared; it was detached from the bone for a considerable distance round the margins of that excavation.

Case LXVIII.—James L., aged four, came under my care into Charing Cross Hospital, January 13, 1879, in the first stage of hip-disease on the right side. He had the third stage of phimosis. There was no lengthening, but it was difficult to get him to walk; when he did so, the step was irregular. The right foot was barely advanced, but brought slowly to the level of the left; then the other took a rapid step, during which the body was thrown over to the right. The boy had an abscess, still deep, on the top of the thigh, outside the origin of the rectus.

For a long time the boy was kept in bed; the abscess gradually increased and came forward; the thigh became considerably lengthened. In the middle of May, 1879, the abscess was close to the skin, and was opened and dressed antiseptically till the beginning of June. At that period marked

shortening of the limb set in, and discharge from the abscess greatly increased. I now enlarged the opening and passed my finger into the cavity; it led by a rather narrow channel down to the lower aspect of the neck close to the head. Here osseous grating under the finger revealed through the capsule a carious condition of bone.

June 26th.—I excised the joint, removed the head and great trochanter; found the truncated extremity of the femur soft and becoming carious; stripped off the periosteum and took away an additional piece, which I afterward found measured just over three-quarters of an inch. At the upper posterior part of the acetabulum was a spot the size of a four-penny-piece, bare of cartilage, and the bone, being very soft, was gouged.

I have the portion of femur now before me. At the lower part of the epiphysal and diaphysal junction is a small hole in the bone, but the ulceration extended the whole length of the under-surface of the neck, with inflammatory softening nearly an inch down the inner aspect of the femur. The cartilage of incrustation was detached for a considerable distance around the opening, but was normally thick. At the upper and back aspect of the head was an oval spot, as large as a silver threepence, of cartilage-ulceration, laying bare the bone; a narrow margin of the cartilage around this ulcer was thinned, so that near the edge it was transparent.[1] The ligamentum teres had entirely disappeared, save a few shreds in the digital fossa of the femur. On section, the small hole mentioned above was found to lead to an excavation occupying the lower two-thirds of the epiphysal line and extending some way into the epiphysal head—the hollow contained pus.

I have several other cases of coxitis, were it desirable to quote more largely, commencing at the particular part above described, namely at the lowest point of the line of junction. In all of them the ligamentum teres shows various morbid conditions, from entire destruction to mere hyperæmia and engorgement; yet none would say, I imagine, that the disease commenced at that part.

While wishing to lay some stress upon the frequency with which femoral hip-disease begins about the epiphysal line, and in preference about its lower part, it must be understood that the malady also frequently commences at or about the osseous nucleus, or, if this have taken entirely the place of the primordial cartilage, anywhere in the epiphysal head. I need not here describe articular ostitis, as the subject has been already amply treated at pp. 197–238, but would point out that one reason for the frequency of this condition at the hip is the peculiar, one might almost say inadequate, blood-supply through the vessels of the round ligament. The epiphysis appears not merely to wear away at the surface, but to shrivel, perhaps rather to cease to grow. The annexed plate is from an excised upper part of the femur. There was no vestige of round ligament, the cartilage was absent, the bone-cancelli exposed and granula-

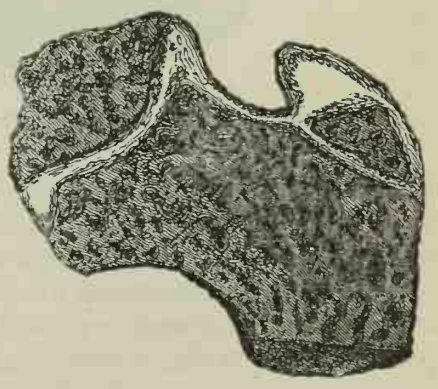

Fig. 46.—Femoral hip disease commencing in epiphysis itself.

[1] I would call attention to the beautiful distinction which Nature here showed between destruction, or rather detachment, of cartilage from ostitis and the ulceration produced by pressure, so clearly seen at the upper part, and which was evidently recent.

ting, the epiphysal line sound, but all the epiphysis soft (osteo-malacia); the girl did well after the bone had been resected.

In former chapters the fact has been accentuated that while in synovial disease the cartilages begin to ulcerate on their free surface, they are in ostitic joint disease generally first invaded from their deep surface, being detached with their articular lamella throughout a larger or smaller extent, and then degenerate sometimes so slowly, that even after months of disease such loosened pieces may be found looking nearly normal among the granulations.[1] This occurs more frequently in exsections of the hip than of any other joint. The size of the detached piece depends on the extent of bone-surface implicated in the inflammation. An ostitis attacking the whole epiphysal head may cause shedding of the whole cartilage, as in the annexed plate. I was obliged to resect the head of this femur on account of an acute disease which threatened life, and found the whole cartilage detached, save from the diaphysal part of the head, where it was still adherent.

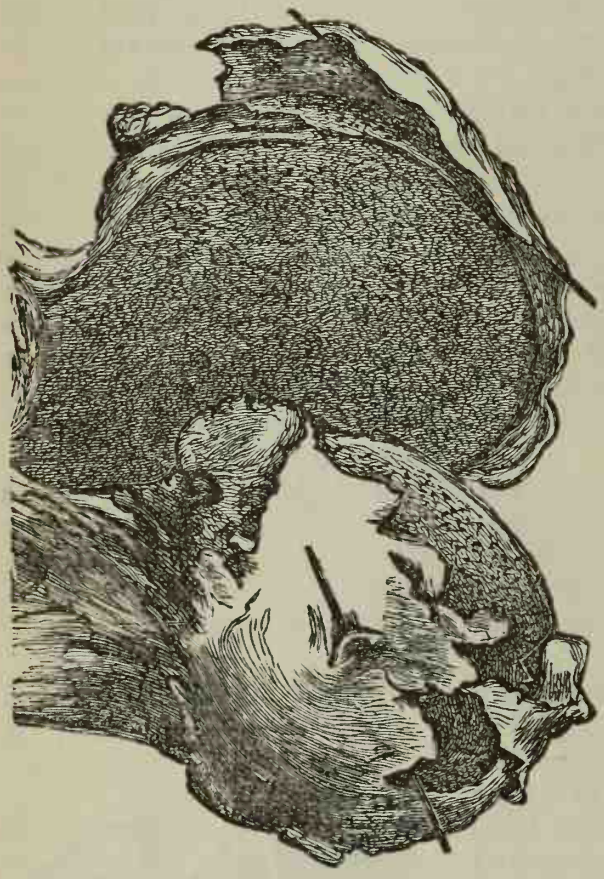

Fig. 47.—Shedding of cartilage in subacute ostitis.

Acetabular hip-disease is, though rather less common than the femoral, a sufficiently frequent affection to require careful study. The annexed plate is from a lad aged twelve, who was treated by me in Charing Cross Hospital while the first few chapters of this work were already in type. Owing to objections on the part of his mother, no operation was performed. While she was still endeavoring to make up her mind, brain-symptoms supervened, and he died rapidly of tubercular meningitis in the early part of June. I was fortunately able, with the assistance of Mr. Whitehead, to secure the parts. The femur and its cartilage were sound, with the exception of the point at the top and back of the head, which always ulcerates from the effect of pressure (p. 280). The cartilaginous circumference of the acetabulum was also sound, except at the point corresponding to the femoral erosion. The cavity was full of grumous, flocculent pus of a pink color (slightly blood-stained). At the bottom of the cavity, where the different limbs of the Y-cartilage join, was a ragged hole, somewhat triangular in shape, which led into an abscess within the pelvis. The intra-pelvic abscess, whose wall was formed by the obturator fascia, both dilated and thickened, was as large as two-thirds of a duck's egg, the larger end being placed so that it projected inward and a little forward from the

[1] I must refer to p. 103 for the explanation of an occasional similar find, even in synovial disease.

inner acetabular wall. It filled, therefore, a large space in the true pelvis, and, merging over or covering the ilio-pectineal line, occupied a certain place in the lower part of the iliac fossa. This is the most instructive specimen that I have seen of the especial form of disease in question ; but other instances and conditions, found during excisions, have long ago made me aware that such malady exists, and clinical studies have taught me how to detect it during life.[1]

Diseases of the hip may also begin in the synovial membrane, but such mode of commencement is less common in this than at any other large joint. I have seen several undoubted cases of synovial hip disease, generally traumatic or arising from over-fatigue, in boys between the ages of nine and fifteen. A careful study of the symptoms will always reveal their

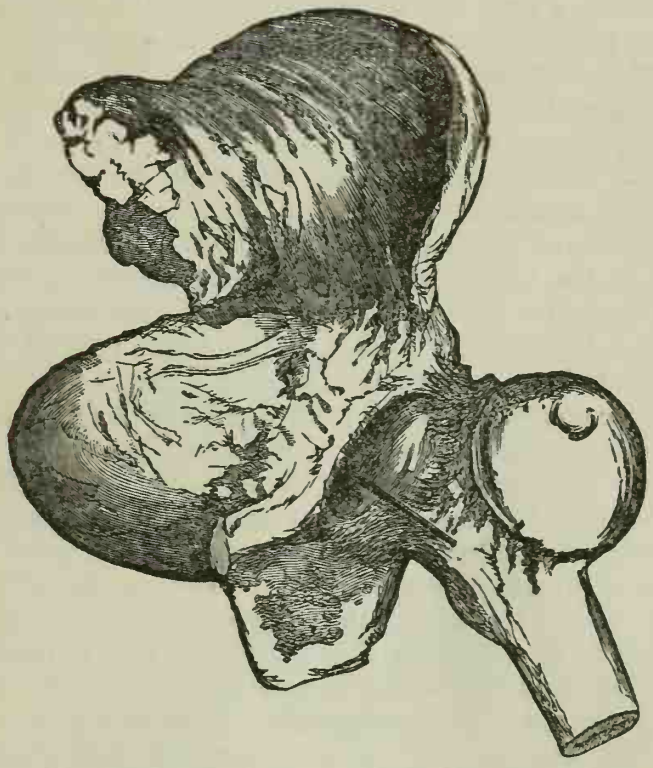

FIG. 48.—Acetabular hip-disease: intra-pelvic abscess.

nature in the earliest phases ; but diagnosis becomes more complicated and difficult, as in later stages the malady implicates other structures.[2]

Hip disease sets up a series of phenomena, which varies somewhat according to the mode of commencement; common to all is this, that the disease is accompanied by contractions of the muscles passing between the pelvis and femur—such contractions produce many of the most evident and most discussed symptoms of the disease. But at present we have nothing to do with symptoms, we are simply concerned to note the effects of these muscular acts upon the structures of the joint. The muscles in question—passing, some horizontally outward to the upper end of the bone, some almost perpendicularly downward to the lower parts of the limb—must and do, when in a state of abnormal contraction, cause the head of

[1] For the mode of making this examination, see p. 302.

[2] I of course exclude from this view cases connected with exanthematous or enteric fever and with hysteria.

the femur to press with unusual force against the upper and inner surface of the acetabulum, while counter-pressure is exerted upon the upper, inner, and back surface of that globe. The result is that in all cases, whether the disease be synovial, pelvic, or epiphysal, these particular portions and aspects of the articular cartilages become ulcerated. Hence, if in pathological examinations we meet with such erosion, we must not at once accept it as the origin and root of the disease; it is a mere pressure-effect, what the Germans call a "decubitus," using, as they do, the same word for a bed-sore; it is nearly, if not quite, always secondary; not the disease itself nor its cause, but the result of disease which generally has begun elsewhere.

To prove this position we have only to look at pathological museums; we shall find a few specimens in which the action is distributed over the whole joint-surface; a very few indeed in which the erosion has chiefly attacked the lower posterior or anterior part of the acetabulum and femur; but in a proportion of cases so large as to render the above examples mere exceptions, the upper lip of the cotyloid cavity and the corresponding part of the caput femoris are ulcerating, while all the rest of the bone may be untouched. Such constancy of action can only be accounted for by the fact that abnormal muscular contraction produces pressure, and thereby ulcerative absorption of these parts. The annexed figure, from Mr. Howship's collection in the Charing Cross Hospital Museum, is not taken from a specimen particularly chosen to prove these circumstances; in fact, it presents an unusual amount of action at the lower part of the acetabulum, evidently produced by the gravitation of pus. Let it be observed how the cavity of the acetabulum has been prolonged about an inch upward; how the head of the femur has been altered in form; how, also, in the position which in life they last assumed, the two fit accurately together, and how the track left behind became narrower as the caput femoris wasted. It is plain from this mere physical evidence that the head of the femur was used almost like a copper-plater's graver, to furrow the cotyloid cavity upward on the ilium, and has been almost worn out in the process. It has been held tightly to the floor of the cavity by the pyriform, obturators, and other capsular muscles, while it was forced upward by those which pass directly downward. The acetabulum is thus made to travel inward as well as upward, whereby an opening through the floor of the cavity into the pelvis is not unfrequently produced, as shown by the figure. I say, that such evident yielding to the pressure upward is not an exceptional case, but is the rule: that when we find a hip-joint ulcerating in any other way and position, it is that some circumstance has caused a primary ostitis in that particular spot. It must also be remarked that as the head of the femur travels upward, producing, in that part against which it presses so abnormally, ulcerative absorption, it causes beyond that point an osteophytic growth of bone, forming a rough lip to the new cavity (according to the law of increased growth and induration beyond the focus of a suppurative inflammation).

We now go on to consider the causes of certain phenomena, firstly of that one which is known by the name of pain at the knee. It often has and doubtless will again mislead diagnosis; because, though in some cases it is not a prominent symptom, it is in others very marked and distressing, before there is any disease at the synovial and ligamentous apparatus of the hip. It would lead us very far to give all the different solutions, right or wrong, which have been attempted, yet it is only proper that some should be quoted. Sir C. Bell attributed this pain to irritation of the obturator

nerve. Sir B. Brodie appears to entertain a similar opinion.[1] Coulson, to continuity of the inflammation along the aponeurosis of the rectus muscle. Richet conceived it to be due to propagation of the inflammation along the medullary canal to the lower end of the bone. Bonnet attributed it in many instances to malposition, which caused a constant strain on the ligaments

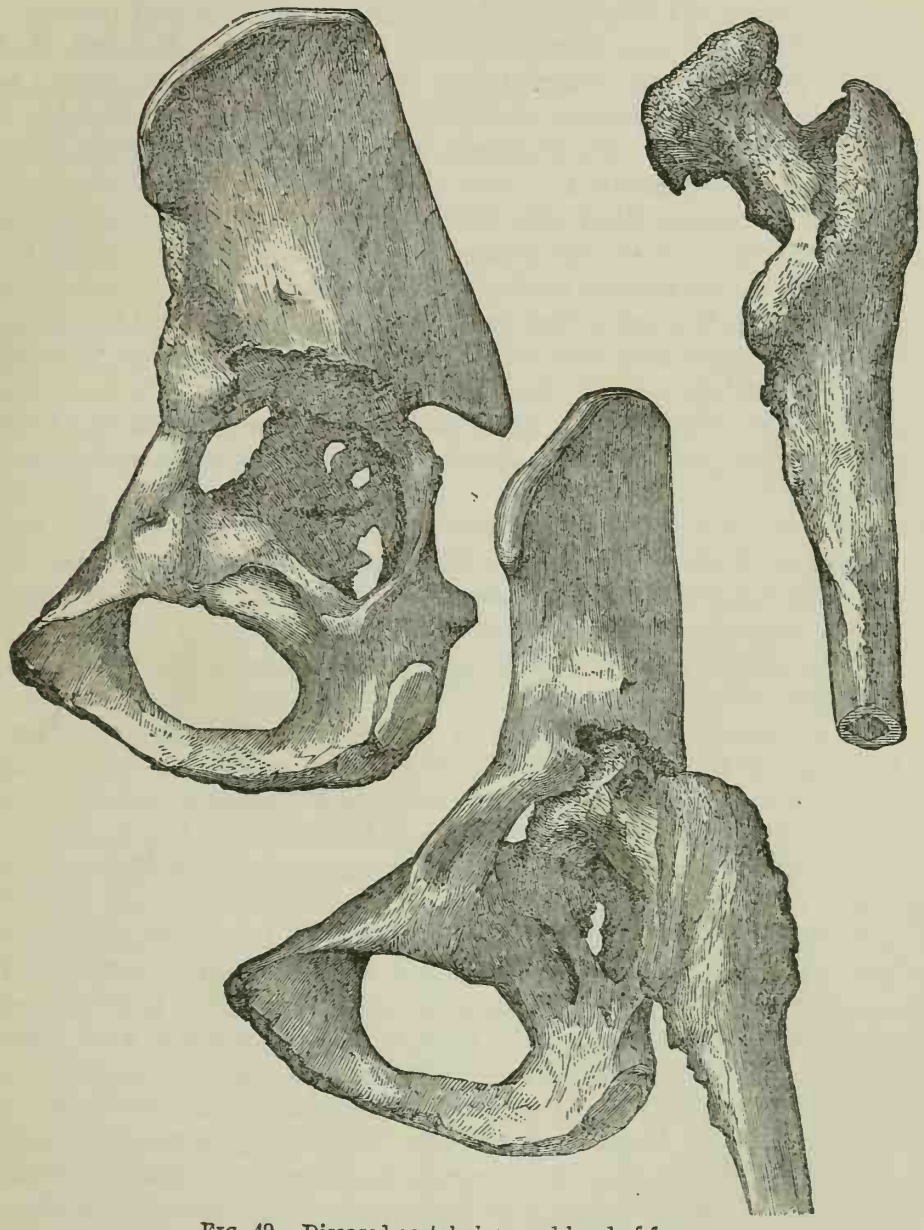

FIG. 49.—Diseased acetabulum and head of femur.

and muscles of the knee. Stromeyer, to spasm of the psoas and iliacus internus. Walther and Fricke, to sympathy between the two ends of the bone.

If we eliminate from these hypotheses those which are merely unsupported speculations, we leave only two tenable views, viz., irritation of nerve-trunks passing close to or supplying both joints, and sympathy between the two ends of the bone. The nervous trunks which fulfil the above conditions are three: the sciatic, anterior crural, and obturator. The first

[1] Op. cit., p. 123.

of these sends a twig to the hip, and three, sometimes two, small branches to the knee. It is doubtful whether this nerve has anything to do with the phenomenon in question, since the branches are supplied to points not involved in the knee-pain.

The anterior crural occasionally supplies a branch to the hip, but it lies in close contiguity to that joint and sends several branches to the knee.[1] A case related by Sir B. Brodie, which bears on this subject, should not be overlooked. "A man was admitted into St. George's Hospital, under the care of Sir Everard Home, complaining of pain in the knee, and of nothing else. On inquiry into his case, however, it was found that he also labored under femoral aneurism. Sir E. Home applied a ligature above the tumor, which immediately diminished in size, the pain in the knee subsiding at the same time. The patient died afterward of venous inflammation, consequent upon the operation; and on examining the limb I found that some branches of the crural nerve lay on the surface of the tumor, which terminated in the exact spot to which the pain had been referred, and this at once explained the origin of the pain, and the subsiding of it on the tumor becoming reduced in size after ligature of the artery."[2]

If pressure produced by an aneurism may cause pain at the knee, so it is probable that the pressure of a swollen hip-joint upon the same nerve may have a like effect.

The nerve, however, whose influence has always, with justice, been considered greatest, is the obturator. The supply to both hip and knee, the place of distribution at the latter joint, the muscular phenomena to be considered in the sequel, all point to the probability that this nerve is, of all the three, that one whose irritation principally causes knee-pain—that is to say, one of the sorts of knee-pain.

Another causation is doubtless to be found in the propagation, not as Richet thought of inflammation, but of morbid sensations along the bone, or, to state it more correctly, the tendency of all painful sensations of bone to be referred to its lower end. This is often marked when a part of the shaft is inflamed or necrosed, but more strongly so when the proximal end is involved. One important fact may be here quoted—"All these sympathetic pains have this peculiarity, that they never pass along the nerves upward, that is toward their origin, and that they are never increased by outward pressure, and this latter circumstance should always produce suspicion of a distant origin of the malady. Lastly, I must remark that these pains usually follow the course of the nerve lying close to the disease; but that there are cases in which they are transmitted along the medulla, or along the periosteum of the bone to its end. Thus I have now under my care an unfortunate boy suffering from caries and suppuration of the hip-joint, in consequence of which the caput femoris is dislocated upon the ilium; has penetrated, by ulceration, through the soft parts, and lies bare, merely covered by delicate granulations. When I press with my finger upon this denuded head of the bone, the patient does not complain of pain at that spot, but, by an involuntary movement, grasps the condyles of the femur, and complains of very intense pain in them, although pressure upon these

[1] I have twice in the course of dissection found a small twig, from the external circumflex branch of the nerve, pass into the capsule of the hip-joint—the same branch sends down a long, small twig to the outer side of the knee, another ramus comes from the vastus internus nerve and goes to the inner side of the knee. The patellar plexus, between branches of this and of the obturator nerve, may also have its influence.

[2] Op. cit., fifth edition, p. 281.

condyles themselves is entirely painless."[1] Having these observations of Wedemeyer's in my mind, I had a few years ago the good fortune to detect the cause of a violent knee-pain in an abscess a little above the middle of the femur. The peculiar pain at the knee produced by pressure on a dislocated and inflamed caput femoris I have been able in two cases to verify.

Of these two sorts of knee-pain, one is situated in a nerve, therefore is connected with inflamed synovial membrane of the hip; the other pain, with ostitis of the head of the femur. Both may be somewhat early in reference to other symptoms; but the latter form, if hip disease commences in the thigh-bone, is very early; it occasionally antecedes all other symptoms, save perhaps a slight limp.

Starting-pains result, as we have seen in other chapters, from inflammatory conditions of parts beneath or near to the articular lamella; thus in ostitis they are relatively earlier than in synovitis, and in this way the interrelation between starting- and knee-pains become clear.

Fixity of the thigh upon the pelvis occurs very early in hip disease; it arises from contraction of muscles, more especially of those immediately surrounding the capsule. The thigh is thus fixed at certain angles, antero-posterior and lateral with the pelvis; fixed, that is to say, as far as any one examination is concerned; yet the posture gradually increases: firstly flexion and abduction become considerably, but by imperceptible degrees, more marked; then arrives a time when a more or less sudden change takes place; flexion remains, or indeed increases, but abduction is changed into adduction. As to the cause of this, nothing distinct is known. The experiments of Bonnet, Dittel, and others, showing that distention of the capsule produces at this joint abduction, does not appear to me to throw much light upon the matter.

Abduction produces a certain peculiarity of form which marks off the second from the first stage of the disease, and which is termed lengthening. Abduction of the thigh on the pelvis may be estimated by eye or otherwise, if the surgeon, standing well over the patient lying supine on the couch, places the tip of the index fingers on each anterior superior spine, thus marking the extremities of a line supposed to be drawn between those points; the other line, that of the thigh, is distinct, running from the centre of the patella to one or the other finger-tip. If these lines meet at angles of about 90°, and are equal on both sides, there is neither abduction nor adduction; the angle, whatever it be, will be maintained by the very postulate of the case—namely, fixity of the thigh on the pelvis. It remains for us to see how abduction, the obtuse angle, produces lengthening; adduction, the acute angle, shortening.

Lengthening of the leg, such as occurs in an early stage of hip disease, is the effect of two conditions; abduction of the thigh, and the necessity of maintaining a certain parallelism of the limbs while the angle of abduction remains the same. With the cause of abduction we have for the present nothing to do, but merely with its effect. Fig. 50 shows the pelvis with the right thigh abducted at a certain angle, *a*, *b*, *c*. It is evident that no child could stand for more than a few seconds in the position necessitated by such posture of the limb—the one foot in the air, all the weight and balance entrusted to the other limb; nor could a person long maintain, unless compelled by splints, such an attitude in bed. Observe that between

[1] Wedemeyer: Bemerkungen über Caries und Necrose, Gräfe und Walther's Journal der Chirurgie, 5ter Band, 3te Heft, S. 626.

the transverse axis of the pelvis, *b*, *c*, and the long axis of the thigh, *a*, *b*, a certain obtuse angle exists; this angle is the postulated abduction, and whatsoever artifice Nature may adopt to render station possible, this angle

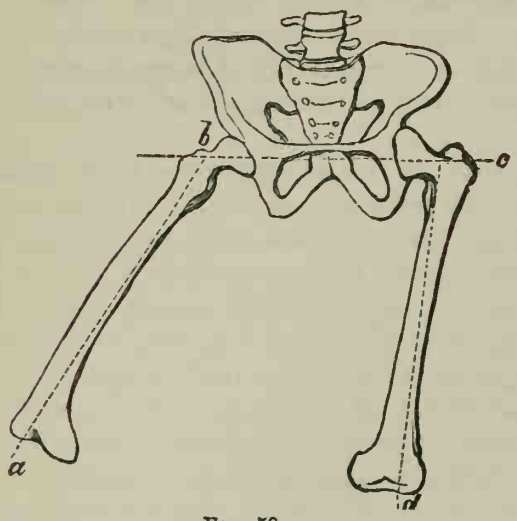

Fig. 50.

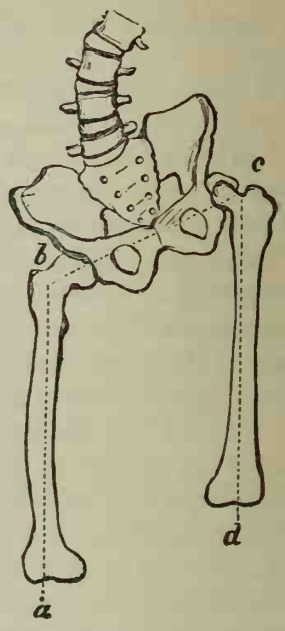

Fig. 51.

must be maintained; but at the same time, for station and for unrestrained recumbency, the thighs must be more or less parallel.[1] The result is this: that to bring about such parallelism, and yet to maintain the angle, *a*, *b*, *c*, the pelvis on the affected side is inclined downward, whereby the acetabulum of that side must be lower than the other, and hence the knee, ankle, etc., are also lower, and the leg *appears, and only appears, longer*. This posture necessitates of course adduction of the sound limb to the same or nearly to the same extent as the affected one is abducted; also the lumbar spine must be curved to the affected (abducted) side.[2]

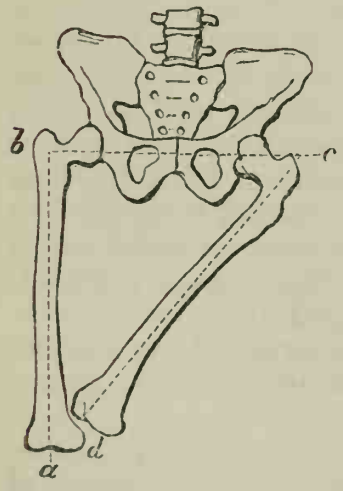

Fig. 52.

We will now describe the causation of shortening. This is also produced by a fixed position of the thigh, which makes now an acute angle with the transverse pelvic axis. Fig. 52 shows the pelvis, with the left thigh adducted: the position cannot be maintained, for, in order to stand, the thighs must be parallel, and yet the angle *b*, *c*, *d*, must, by the postulated condition of adduction, remain unaltered. To effect this, the pelvis is raised on the diseased side, whereby the acetabulum is lifted, and the thigh *appears* shortened. The reader must be referred to the preceding plate (51), the left

[1] The phrase is not strictly correct; the thighs, of course, run in somewhat convergent lines.

[2] A question has often been discussed as to whether, in the absence of any luxation, real lengthening of the thigh be possible. In answer to this I must refer to an appendix to this chapter at the end of the book, in which will be found an account of certain experiments showing such conditions, viz., real lengthening and absence of luxation, to be mutually incompatible.

side being now taken as diseased, with the acute angle *b, c, d.* Of course the other limb will be proportionally abducted, and the spine curves to the sound (abducted) side.

These positions—abduction or lengthening, adduction or shortening—must be examined by both eye and hand; measurement by the tape or other means gives very unreliable results; for, as must be evident, these positions, with flexion of the thigh constantly present, together with swelling, which rarely is absent, alter not only the relative distances of all parts of pelvis and femur, but also render the line of the tape uncertain,[1] whereas the apparently lengthened thigh very often measures shorter than the sound one. This subject will be again broached in the next section.

Shortening, therefore, generally so called, is a mere posture; like lengthening, it is apparent; but we must consider if there be such a thing as *real* shortening without luxation. We have seen that, as a result of hip disease, the upper part of the acetabulum becomes worn away, or, in other words, ulcerates in an upward and backward direction; the head of the bone, therefore, without quitting the enlarged cavity, assumes a higher position in regard to the pelvis. Moreover, the caput femoris itself undergoes a similar ulcerative or absorbent process, whereby its summit becomes abraded, producing on the relative position of limb and trunk the same effect, namely, a higher position of the femur in regard to the pelvis. Hence, although lengthening cannot be produced unless by luxation, there may be a certain amount of shortening while the head of the bone is still in the acetabulum. On the living subject we have at present no means of estimating what proportion of shortening results from mere posture, and what from bony absorption. Another point concerning position during the stage of shortening should be mentioned, namely, a very frequent abnormal projection of the trochanter. I say frequent, because it is not constantly observed. Its non-detection is due, I believe, only to fatness of the patient, since I have never failed to find it in thin persons during this stage. Some stress has been laid on, and I think unnecessary mystery thrown around, this appearance, which is produced partly by the riding up of the thigh and acetabulum, and partly by adduction. The pelvis is broader above than at the acetabulum, and the abnormal prolongation of the acetabulum is shallower than the cavity itself; hence, in gliding upward, the thigh-bone takes a position further out. Adduction also of the thigh, since the top of the trochanter lies above the axis of motion at the hip, must in diseased, as it does in normal, subjects, cause that process to project.

Another part of the peculiar posture of hip disease depends upon flexion of the thigh. Under certain circumstances this position is difficult to detect, and its characteristics require explanation. Let the diagram (Fig. 53) represent the skeleton of a person with hip disease of the right side. The person is supposed to be standing on the left foot, the right limb slightly bent at the hip to an angle, represented at the meeting-point of Nélaton's line, *a, b,* and of the femoral axis, *c, e.* The angle *c, e, a,* is that which, by the same postulate as for lengthening and shortening, is to remain the same, the fixity of angle being the fundamental necessity. Now, if the patient thus standing be told to put the knees together, he will do so without altering the angle *c, e, a;* but to effect this the position of the pelvis is changed,

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[1] I am anxious to lay considerable stress on this matter, since in so good a work as the Science and Art of Surgery, measurement is inculcated in these words: "All this may be readily ascertained by measuring from the anterior inferior spine of the ilium to the inner ankle."—Seventh edition, p. 310.

it becomes much more horizontal; the posterior surface of the sacrum looks upward; the coccyx and tuber ischii project, and the lumbar spine curves forcibly (lordosis).

The same thing happens to the recumbent patient; and if the reader will hold the book, so that the diagrams represent the parts lying on the back, he will at once see the result of endeavoring to straighten the thigh. The appearances and their possibly deceptive character will be referred to in the next section.

The inflammatory acts and caries which are the essentials of morbus coxarius are frequently followed by suppuration. The abscesses may point in different localities, according to the place of their formation. Many writers have, however, too readily assumed that all these abscesses are produced by intra-articular suppuration, and that they communicate more or less directly with the joint-cavity. Herein is error; a large proportion of them, as at other joints, belong to the class of peri-articular and adjacent abscess; therefore any positive conclusion concerning the exact place of

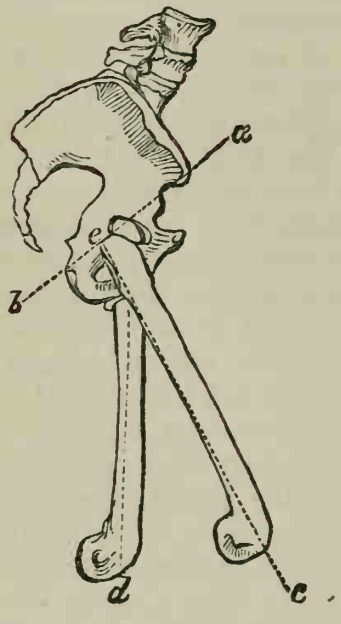

FIG. 53.

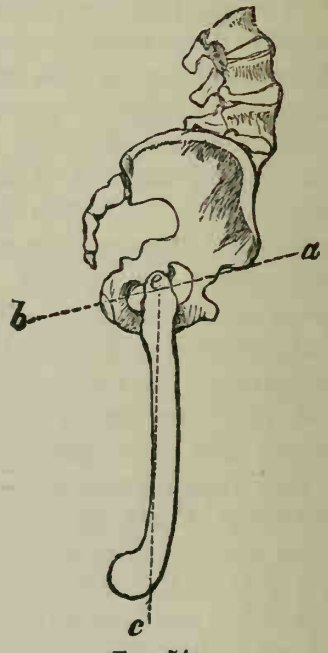

FIG. 54.

greatest diseased action is not to be drawn from the spot at which pus approaches the surface. The position assumed by the patient, or enforced by the surgeon, influences, through the force of gravity, the locality for pointing; yet sometimes the disposition of fasciæ and of muscles will cause pus to work its way in a direction against its own weight. Pus, rapidly formed in the depths, passes to the surface by a more or less direct course; takes the nearest route, which the resistance of parts renders possible; but slowly secreted pus frequently travels a long way, skirting by fasciæ, passing between muscles and encircling bones, previous to pointing at the skin. Thus I have traced a sinus from just above the knee to a carious neck of the femur; and a hip-joint abscess pointing a third down the inner aspect of the thigh is by no means uncommon. A usual place for pus to show itself is behind the great trochanter, but such abscesses are by no means derived immediately from the back of the capsule. On the contrary, many of them are traceable through the small sacro-sciatic foramen into the pelvis, originating from the inner wall of an inflamed acetabulum, and

passing along the track of the obturator internus muscle.[1] Abscesses at or a little below the crural arch are also generally due to ostitis of the pelvo-cotyloid septum, while those that point a little further out (just below the anterior inferior iliac spine, like those that make their appearance about the inside of the thigh) are usually connected with disease of the head and neck of the femur. Pus formed on the lower aspect of the femoral neck, usually courses backward along the obturator externus tendon. I have, however, found it advancing in an opposite direction, and passing from under the outer margin of that muscle to the front of the thigh.

There yet remains another condition for our study, namely, dislocation. The term requires some definition. A femur which, together with the acetabulum, has travelled upward (see Fig. 49), may in one sense be called dislocated, if by that term we mean simply displaced; but if by the word we mean that the head of the femur, however altered, lies no longer in the acetabulum, be it ever so much changed, then in such a case as is depicted in Fig. 49, the thigh is not dislocated. I use the word in the latter sense as a synonym for luxated (having quitted its socket), and am able to affirm that true dislocation does occur in hip disease, and not so very unfrequently as some writers would have us believe.[2] I have five times, to my *certain* knowledge, and I think once or twice oftener, resected the head of the femur from the dorsum ilii and quite outside the cavity. I myself have twice, and in my presence Mr. Canton has once, met with this remarkable condition; the caput femoris lying on the edge of the glenoid cavity, and when it has been removed, a distinct semicircular impression of that edge, produced by absorption and partly by squeeze of the femoral cartilage, has shown that the bone had been there for a considerable time. To this condition I shall recur. It is evidently comparable to the pathological subluxations of other joints.

FIG. 55.—Head of femur. Cartilage grooved and ulcerated by pressure on edge of acetabulum.

When the luxation is complete, the head of the femur is placed nearly always on the dorsum ilii; yet on December 18, 1868, I assisted my late colleague, Mr. Hancock, to resect a hip, and found the head of the femur on the pubes. Mr. Holmes[3] figures a case of pathologic dislocation on the anterior inferior spine. These are the only two exceptions, that I know of, to the usual law. This very constant tendency in one direction, and the occasional remarkable grooving of the cartilage, shows luxation to be produced by the over-action of certain muscles, aided by relaxation of ligaments, and probably by a peculiar position. The posture, which many patients assume, is to lie on the sound side, with the corresponding thigh pretty straight; while the unsound thigh is flexed on the abdomen, thrown across the other limb, and allowed to rest by the inner condyle on the bed. The sound thigh then acts as a fulcrum; the mass of the diseased one as power, which lifts up and away from its socket the weight, *i.e.*, the head of the femur. The tendency produced by this position is aided in many cases by diminution in size of the epiphysal caput femoris; by absorption

[1] It must be remembered that abscesses opening at the spot above mentioned are due to several diseases producing intra-pelvic abscess, especially to caries of the lower lumbar or sacral vertebræ, as also to sacro-iliac disease.

[2] I think Mr. Holmes (Principles and Practice of Surgery, p. 466) gives, by his observations on this subject, too strong an impression of the rarity of real dislocation.

[3] L. c., p. 466.

of the acetabular lip ; by loss or relaxation of the cotyloid ligament. Such luxation is often, as has just been shown, a gradual, not a sudden event.

There is another condition whereby symptoms completely simulating dislocation may be produced, namely, separation of the epiphysal part of the head from the rest of the femur. Jane McW., aged seven, who came into Charing Cross Hospital under my care, May 9, 1864, suffering from left hip-joint disease, and whose history is detailed in another chapter, is an instance of this event. Pus had formed about the joint, and I resected it with the expectation of finding a dislocation. The head of the bone appeared to lie out of the acetabulum, and to be reduced to a button, whose extremity, however, was peculiarly flat, bounded by an unusually sharp edge. After taking away this part, together with the trochanters, I passed my finger into the acetabulum, and found lying loose among the granulations sprouting from its wall a portion of bone. This, removed with dressing-forceps, was found to be the detached and necrosed epiphysal head. A similar case occurred in the practice of one of my colleagues three years ago. The mode in which this event may ensue from extension of such ulceration, as is shown at Fig. 45, along the epiphysal junction, is easily comprehended. Sometimes such separation, taking place more slowly, allows time for other processes to become completed, namely, adherence by granulation of the epiphysal head to the acetabulum ; so that when diastasis is complete, the detached portion remains living, being nourished by the vessels of the new adhesions. Thus John C., aged nine, on whom I performed excision in December, 1874, and in whom I found the neck of the femur truncated as in Jane McW. ; but the bottom of the acetabulum was filled by an attached portion of bone, around which was a narrow circular groove, interrupted in places by bony bridges. As the free surface of this bone was granulating freely, I thought it my duty to leave it *in situ*. There was no possibility of doubting that it was the detached epiphysal head of the femur. A girl came much under my notice in 1875–76 who had some symptoms of dislocation, but also much mobility of the femur, which could be elongated by traction and shortened by upward pressure : it also could be freely rotated. The head of the bone could nowhere be felt, either on inward or outward rotation ; but when by traction the limb was brought to the same length as the other, a little jerk and jolt was felt, which was repeated, as on releasing the limb the thigh began to shorten again.[1] The two events just described, viz., real dislocation and diastasis, are, the one not very frequent, the other rare ; still the possibility of their occurrence in all cases must be borne in mind.

In order to gather again the events among which our somewhat scattered narrative has run, I will in a few words recapitulate in their order the pathological acts. An inflammatory condition of some part of the joint (nearly always the bony) gives rise to neuro-muscular irritation and contraction which, fixing the thigh at certain lateral and antero-posterior angles with the pelvis, are the efficient causes of lengthening or shortening (apparent) and of flexion (or pelvic backward projection). These contractions also, by forcing the head of the femur with abnormal violence upward and inward against the acetabulum, favor ulcerative action of the opposed surfaces of both bones. They may also cause, as in other joints, dislocation total or partial.

But this history, though it may account for the phenomena of hip dis-

[1] Dr. Lewis Sayre was round the wards with me while this girl was an in-patient, and confirmed my diagnosis as to diastasis.

ease, when once the malady has begun, gives no reason for the frequency of its occurrence in children below the age of puberty. What has been said concerning the great formative activity going on about the pelvis and intra-articular femoral neck; the fact that under the influence of struma such osseous hyperæmia is extremely liable to overbalance into congestion and inflammation; the coincidence of this period of rapid growth with the first efforts and with the many tumbles and blows about the lower limbs essential to attempts at walking—may point to the conclusion that a certain proportion of hip cases are both strumous and traumatic. Nevertheless, I confess to a strong opinion that another physiological and potent agency has a large share in the etiology.

A good many years ago I was struck with the fact that nearly all the boys admitted for hip disease into Charing Cross Hospital had congenital phimosis. In a short time this coincidence was found to be nearly, if not quite, constant. At last, in the middle of 1873, I began to note, in a hundred male cases of hip disease occurring in my private practice or admitted into hospital, the presence or absence of this condition; for the sake of better classification divided into classes:

CONDITION OF PREPUCE IN 100 CASES OF HIP DISEASE IN BOYS UNDER TEN YEARS OF AGE.

First degree.	Second degree.	Third degree.	Elongation.	Normal.
39	27	17	11	6

THE SAME, DIVIDED INTO AGES.

Years.	First degree.	Second degree.	Third degree.	Elongation.	Normal.
2 to 4....	3	2	0	1	1
4 to 6....	7	5	2	3	3
6 to 8....	16	11	9	4	1
8 to 10....	13	9	6	3	1

First degree: the opening in the prepuce a mere pin-hole, so that on retraction no part of the glans, or only a minute portion of the urethral lips, could be seen. Second degree: in which all or a considerable part of, but nothing beyond, the urethral orifice could be uncovered. Third degree: in which the prepuce, when retracted, uncovered some portion, but only a portion, of the glans. Fourth degree: elongated prepuce, projecting more than a quarter of an inch beyond the glans, but capable of entire retraction. Fifth degree: normal.

The first line of this table is very significant, when it is considered that the cases are not picked or chosen, but represent every hip disease in the male that came under my notice[1] from the end of 1873 up to the middle of

[1] My colleagues at the hospital had kindly permitted me to make use also of their cases for statistical purposes.

1878, when my number was complete. It will be observed that of these cases, eighty-three have phimosis; that only six have normally-formed prepuce; and that from complete, or the first degree of phimosis, to which class more than one-third of the cases belong, the number steadily declines to the normal. I would also point out that these are not fortuitous coincidences, because, for two years at least before commencing tabulation, this association was remarked. Furthermore, I asked my friend, Mr. Morrant Baker, to inquire for me about the prevalence of hip disease at the Evelina Hospital, which is largely used by Jews. He tells me that few children are there admitted for hip disease, and that most of those so received belong, not to the Jewish, but to the Christian community. I have appended also the second part of the table—that which divides the cases into ages—although I think in certain ways the division is not very reliable; for, finding it impossible to ascertain from the parents the exact period of commencement of the disease, the age at which I saw the child or admitted him into hospital has been recorded. Children of course came under my notice in all stages of the malady, hence the table shows nothing as to the time at which it commenced.

The important fact, however, is simply coincidence of phimosis and hip disease—a coincidence which I should never have dreamed of or imagined had it not been forced on my observation. Upon the mode in which the one influences the other I would rather not speculate further than to point out that phimosed children have facile, frequent, and often long-continued priapism; that this condition, unnatural in the infant, must produce after a time a certain irritability or irritation of the lumbar spinal cord; that from this part the various nerves of the pelvis and lower limb are given off; that the influence of spinal irritation on the trophic nerves is well known; and that just at this particular period large trophic changes are in progress about the hip-joint.[1]

Of course I have not overlooked the fact that hip disease also occurs in female children, though I believe less frequently than in the male.[2] I regret exceedingly that I did not simultaneously tabulate such cases, as I am now engaged in doing; but this I can say with certainty, that in a large proportion of girls, afflicted with hip disease, will be found vulvitis, even vaginitis with or without discharge, and generally, I believe, produced in the first instance by thread-worms creeping from the rectum to the vagina. In a certain proportion will be found protruding nympha or nymphæ covered by a cuticular surface. Further than this, as my numbers are incomplete, I am disinclined to go.

Having now given the description of the morbid processes and the causes of certain phenomena in the usual chronic hip-joint disease, I must refer to certain acute forms of the malady, which are fortunately rare. Some of these are referable to rapid suppuration within the joint-cavity, occasionally a sequela of some general fever; some are the result of injury; others of exposure to cold. In such cases any distinction between the differ-

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[1] While these sheets were passing through the press, two boys, children of wealthy parents, came under my care with hip disease and phimosis. The parents in both instances declined to have them submitted to operation. I succeeded by the extension-splint in keeping the disease in the first stage, but neither child got well until I contrived a means of preventing them getting their hands during the night below the waist. One of the boys then rapidly improved and is at this time well; the other, whose nervous system was considerably affected, is more slowly improving.

[2] During the time that I was collecting one hundred cases of male hip disease I saw only seventy-four girls thus affected.

ent forms of disease are unnecessary or impossible, although I may point out that, when such disease is secondary to an exanthem or to typhoid, it is synovial (p. 77); when to a sudden chill occurring in a depressed state of a young person's system, it is generally ostitic or osteo-myelitic (p. 197); while a traumatic coxitis may be either one or the other. Occasionally acute symptoms of very severe character supervene on a chronic malady, the pain becomes suddenly very intense, and the posture-shortening strongly marked. Now, of all cases of hip disease in which dislocation has occurred, by far the larger number have at one time or other been marked by an acute or subacute exacerbation. I believe that these sudden acute phases of otherwise chronic cases are as a rule, if not always, due to partial luxation, which generally is but the commencement of complete dislocation; all the resected heads marked by a semicircular groove concavity downward, the impress of the edge of the acetabulum, have been operated on for violent symptoms supervening on chronic disease. Nay, more; in three instances of greatly pronounced faulty position, coming on very rapidly, which I have under chloroform restored, there has occurred that unmistakable little snap or slap, utterly different to muscular or tendinous yielding, which indicates the coming together of two previously separated surfaces. From the fact of this grooving—from the very frequent exacerbation that usually, if not always, precedes the discovery of pathological dislocation—it is to be concluded that this event often takes place slowly, and that partial luxation may last a certain indefinite time, often, I believe, several days.

When the malady does not originate in acute or subacute ostitis or in osteo-myelitis, the luxation, when completed, is usually followed by almost instantaneous relief: moreover, the pelvis, which previously was oblique and very high on the diseased side, begins immediately to recover its normal position. This recovery is often very rapid; the limb, of course, remains short. It is on this appearance, viz., a greatly shortened limb with straight pelvis, that the diagnosis of spontaneous luxation is in great part based (p. 308).

Hip Disease Symptoms.—Every now and then, but fortunately not very often, we encounter cases of disease in or about the hip-joint of an acute or even of a per-acute kind. This form occurs about or after puberty, is accompanied by high pyrexia, usually ushered in by rigors, and produces such atrocious pain that preservation of life under such conditions appears extraordinary: yet the patient may even get well, with but little lameness, or may override the malady so far as to let it lapse into the chronic form, or, under certain circumstances, the pain and pyrexia cease almost suddenly, and, on examination, dislocation will be recognized.

To trace with minute accuracy the progression of local symptoms in such cases is impossible; for when first called to such a patient the surgeon will find him watching with anxious fear lest any contact, or any shake, even of the bed, should jar the limb. The thigh is flexed, sometimes very much flexed on the trunk, and is often grasped a little above the knee by both hands; partly to keep it still and to avoid the effects of muscular tremor or spasm, partly because pressure affords some relief. The limb is nearly always adducted—therefore shortened. In fact, the two earlier stages have been rushed through, and the third phase reached in a few hours. To turn the patient about, to lift him from the bed, is an abominable cruelty, and we accept, until an anæsthetic be administered, these appearances as evidence enough to form a diagnosis. The pain, however severe, cannot be continuous, because the child, exhausted after a time by sleeplessness and suffering, does get snatches of uneasy slumber, waking up, however, very

frequently with a frightened cry or shriek of agony, to weep for a time, and then to doze again ; very often, however, moans and facial expression of suffering continue even during slumber.

These symptoms are due on the one hand to acute synovitis, as it appears in other large joints, and on the other to osteo-myelitis or acute ostitis. Occasion will arise, when we speak of treatment, to show the singular, often the curative effect of change of position, also to mention the possibility, if to these acute phases succeed more chronic symptoms, that a partial luxation may give rise to this intensity of suffering. But this class of disease is truly not the subject of the present chapter. The student may easily arrive at the phenomena exhibited by acute hip disease if he will conjoin the symptoms of such disease in joints generally (pp. 53 and 203) to those special to morbus coxarius, of the more usual form, now about to be described.

As the place of origin of chronic hip-joint disease is variable, so must the early symptoms of the malady differ. They differ, however, not in kind, but rather in their relative intensity, in the order of their appearance or culmination, and in their mode of manifestation. The distinctive marks, between osseous and synovial disease in other joints, have already been discussed at perhaps even a tedious length ; yet I cannot help saying here a few words more upon the same subject, because the distinction is, at the hip even more than elsewhere, very clear to him who knows the meanings of certain phenomena, and also because the variety of symptoms, which are presented by the malady, form only a confused and confusing image, unless the causes of the differences be understood. Let me illustrate this by pointing out, that when inflammation or even suppuration about the epiphyses of the femur arises, certain pains, forms of lameness, etc., are produced, while as yet there is no effusion or suppuration within the joint-cavity, no morbid change of the parts which form its walls. We have, namely, so-called symptoms of morbus coxarius, while as yet in the hip there is no disease. After a time the symptoms vary, as the cavity and investments of the joint become affected. Or, on the other hand, the movement of events is in a contrary direction ; the symptoms then exhibit a different course, what in the former were secondary are now primary. The phenomena are massed together under the name hip disease ; nevertheless, care in investigating and acumen in perceiving will enable us to distinguish the two classes of case.

Limping.—The class of hip disease, which especially constitutes our present subject, is, at all events in its earlier manifestations, essentially a chronic malady, the only local symptoms being, for a time, for even from two to three months, a certain amount of lameness, which, often accompanied by a worn aspect, disinclination to play, and general out-of-healthedness, is only observable after fatigue, perhaps quite at first after unusual fatigue. Thus, the child is quite free of lameness in the morning, also on those days when he does not go out, or when he gets less running about. The limp, therefore, may be absent for a week or so, and then return, perhaps to remain permanent, perhaps again to intermit. As time goes on, each attack of limping will be more marked and more persistent than the previous one. Occasionally the child, when questioned, acknowledges certain vague pains ; often no such confession can be elicited. In certain other cases the limp is worst in the morning.

Lameness.—When fully established, the peculiar form of lameness is by no means in all cases the same. Sometimes the child will drag the leg, to avoid, or at least to postpone as long as possible, lifting the foot from the

ground; or he will never put it in advance, but only bring it up slowly to the level of the other; then the sound limb is brought forward with great rapidity; the rhythm of the foot-fall being thus changed from an even division of time to what a musician would call dotted notes (♩♩♩♩ is varied into ♩.𝅘𝅥𝅯♩.𝅘𝅥𝅯), while the space of ground covered by the affected limb is always behind that occupied by the sound one. These manœuvres may be carried on without swing of the trunk, or to each one of them a certain body movement may be added. 1. When the unsound foot is dragged or lifted, the body will be slowly inclined to the sound side. 2. When the weight comes on the unsound limb, the trunk is quickly thrown over to the sound side. 3. During the same distribution of weight the body may, but this is rare, incline to the diseased side. Any of these limps may be effected without turn or twist of the limb, or some eversion of foot and knee may be superadded. In some cases[1] the limping may be observed to have the following periods of greatest intensity: In the morning, on first rising, there is some lameness, which goes off entirely in the earliest beginning of, and only partially a little later in the disease. Toward evening, or after any continuous exercise, limping returns, is more marked than in the morning, and becomes more and more so as the day goes on, or fatigue increases. In older persons, who can define their sensations, stiffness is complained of in the morning, while in the evening, or after long exercise, pain more or less acute, with a sense of fulness, is felt. In other cases the limping, least marked in the morning, gets worse and worse throughout the day.

Pain and Joint-tenderness.—Nevertheless, it must be observed that every limp is not produced by pain; but by an instinct, perhaps an experience, that certain acts will cause pain; or, again, by a sense of insecurity rather than from any other source. This sort of joint-tenderness in a young child, is estimated with great difficulty; but this we know, that from many a limping hip-affected child no expression of pain can be elicited save by an amount of violence sufficient perhaps to hurt a sound joint, or frighten all but the boldest child. Other children, not more severely affected, manifest signs of suffering simultaneously with the limp; others, a few days or weeks after commencing to be lame, will not walk or even stand, but, when placed erect, cling to the mother's skirts, draw up the affected leg and scream. Such a patient will also be watchful at night, starting up frequently with a moan or a cry (early starting-pains). Most children with hip-disease in the first stage sleep on the sound side, some on the back, a few on the affected side—all will keep the leg flexed.

Many of these children, if old and intelligent enough to be questioned about the locality of pain, point to the knee; some to a pretty definite spot on the internal condyle, a few lines from the inner margin of the patella; others, less distinct, indicate all the front of the knee, and one or two inches above it. Some have certainly no knee-pain in this phase of the malady, but suffer from a vague pain either in the front and inner aspect of the thigh, near the apex of Scarpa's triangle, or more rarely about the dorsum ilii, outside the anterior superior spine.

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[1] Already even in this earliest phase different cases manifest certain variations in the symptoms, which have been too frequently and persistently ascribed to differences of constitution, temper, idiosyncrasy, even to mere chance. These peculiarities I. in 1860, ascribed to different localization of the primary inflammation, and in that view I am confirmed by the careful observations of nearly twenty additional years. To keep my narrative succinct and clear, I shall mark the modifications of symptoms simply by the words "in some cases," "sometimes," etc., afterward they will be collated under their proper heading in a tabular form.

In some cases at this time a soft deep tumefaction may be detected behind the trochanter and in the groin; or the glands in the latter locality may be enlarged; but swelling belongs more especially to the next stage of the malady. Also in certain cases rapid wasting of the limb is an early—sometimes a very early—symptom; but this too, as it is more frequently a marked symptom of the later stages, we shall consider in the sequel.

Fixity of Thigh.—A certain loss of health and vivacity, modes of limping, and different sorts of pain—are all the guides that are usually given in books to lead the surgeon's diagnosis. Each of these is doubtful; and even if taken altogether, are, especially if pain be at the knee, enigmatical. But there is a symptom which, for diagnostic purposes, is worth more than all the others, namely, fixity of the joint; its value, however, depends upon the choice of a judicious mode of investigation. It used to be the plan to seize the patient's limb about the middle, and with a quick jerk drive it upward, thus attempting, too often with success, to elicit a cry of agony, accepted, not always correctly, as indicating with certainty the presence of hip disease. This unnecessary violence is usually injurious if there be any hip affection; moreover, the joint, or at least one of its bones, may be really diseased, and yet this manœuvre will lead to no diagnosis. The better method is to watch the forms of limping and mode of station; to let the child be stripped at least up to the waist; and having elicited answers by word or gesture about pain, to place him supine on a sufficiently unyielding mattress. The knee, if it be the seat of pain, should be thoroughly examined, also the ankle and foot; thus eliminating the possibility of lameness arising in any of those parts. During this time the surgeon will, by kindly words and gentle tact, gain the patient's complete confidence; then, instead of examining the diseased limb, let him first investigate the sound one; let the patient lift it perpendicularly into the air, and lay it flat on the mattress again; let him then do the same with the affected one. While this is being done, the surgeon must observe if the pelvis move with either limb, or remain quiet and still; also, when the suspected limb lies flat, he must see if the loins are in contact with the couch, or are bent up in an arch (see p. 299). Now the surgeon takes the sound limb in hand, just below the knee, bends the thigh up to the abdomen, straightens it, abducts, adducts, circumducts, rotates, watching very narrowly, not the manner in which the thigh moves—that does not matter—but the way in which the pelvis remains still or nearly still; that is the important point. Next he takes the limping limb by the tibia, just below the knee-joint, and very gently moves it in the various manners above specified, watching in the same way, not the thigh, but the spine and crest of the ilium, the ramus of pubes and ischium. If the hip-joint be diseased, these parts will move with the thigh, will follow closely its slightest stir; so that the surgeon will at once perceive that it is not the femur that is flexed, extended, or circumducted at the hip, but the side of the pelvis, which plays with every motion of the thigh, in part on the sacro-iliac joint, in part on the lumbar spine, so that in reality the head of the femur is quiescent in the acetabulum. In the very earliest phase of the malady, while the disease is still very slight, the thigh will move to a certain small extent in its socket, but not to nearly the same limits as the other leg; moreover, certain actions, namely, abduction and inward rotation, are more narrowly barred; the investigating hand may feel an elastic check at the moment when the pelvis takes up the movement. By these means the surgeon can detect the very earliest beginnings of hip-joint disease; and by using them he will bestow on his patient the benefit of not being hurt, while he will procure to himself the advantage of having in fu-

ture to do with a tractable, pleasant, and easily managed patient; whereas, if violent or painful means of diagnosis be resorted to, he will, in his after-dealings, be confronted by the shrieks and antagonism of a child very justifiably frightened and angry.

Second Stage.—*Posture Symptoms.*—The initial stage, whether it continue only for a few days or for months, is followed by phases marked more especially by certain postures. Although in some cases these stages are not very distinctly separable from each other, and although a more or less arbitrary division of one continuous disease into separate portions and fragments may not be quite consonant with the uninterrupted progression of the malady, yet, for the sake of clear comprehension and description of the various complicated appearances, it is necessary to distinguish certain sets from other such groups of associated symptoms. The value of this classification is merely clinical, and relates only to semeiology; we may conclude that the appearances indicate certain processes of disease; but with morbid anatomy the division into stages has no direct connection.[1] Ford's classification is still the best,[2] is sanctioned by nearly a hundred years of use, and is based upon prominent symptoms easily detected. Although it is true that occasional cases may modify, even reverse, the sequence of events, yet, on the whole, the division holds good and is true to nature. In this classification the cessation of the first phase is marked by a peculiar posture, to which, as to the whole second stage, the name of lengthening has been given. The third stage is characterized by, and called the stage of, shortening. Of course it will not be for a moment supposed that these two conditions are the only phenomena of the phases in question; they are simply most easily demonstrable at the bedside. We will now study the methods of investigating the existence of lengthening and of shortening, the mode of their production having been already discussed. With regard to lengthening, I must remind the reader that, save in very exceptional cases of downward dislocation, it is in hip disease merely apparent. Shortening may be entirely real, as in luxation, or, in the later stages of non-dislocated cases, may be partly real, partly apparent; but in the early part of the third stage, that is, on its first appearance, shortening is, like lengthening, merely apparent.[3]

The investigation as to lengthening and shortening must be made in the erect and in the recumbent position. For the former, the patient must stand with the back to the surgeon, the garments, if the child be quite

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[1] Mr. Holmes (Surgery: Its Principles and Practice, Second edition, p. 464) divides hip-joint disease into three stages, thus: 1st, stage of inflammation; 2d, stage of abscess; 3d, stage of real shortening. This classification appears to me inadmissible in every way. Its first stage includes lengthening and shortening, commonly so called, also a number of other phenomena which, if we classify at all, ought to be kept distinct, and during which abscess frequently occurs. Again, the advent of abscess among the deep parts is often quite occult, sometimes not suspected until revealed by the knife, sometimes altogether absent, therefore such classification is more fit for the pathologist's room than for the bedside. Moreover, inflammation, which marks Mr. Holmes' first stage, is not by any means confined to that phase, but continues throughout the whole disease, causes the abscess, and pervades the malady from beginning to end. Furthermore, real shortening is often extremely difficult of recognition.

[2] Ford: Observations on Diseases of the Hip, 1794.

[3] For the proofs of the non-existence of real lengthening save by luxation, see Appendix to this chapter. It is well, too, to remind my readers that certain irregularities of growth, quite independent of any inflammatory affection, occasionally produces differences in the length of the lower limbs, the right being usually the longer. For a full elucidation of this subject see my work On Lateral Curvature of the Spine, Third edition.

young, entirely removed, or, in older persons, the chemise or night-dress turned up to above the waist. The appearance, if the phase be that of lengthening, is as follows: The patient stands on the sound foot; the other will be advanced, resting sometimes on the sole, sometimes merely on the toes. The knee is bent, and lies in a plane anterior to the other. It is also separated laterally from the sound limb. The buttock is flat-looking, flabby, and nerveless; the fold between nates and thigh hangs low and listless; the post-trochanteric fossa is shallow and wide, or altogether absent; the whole form of that side is broader, *i.e.*, the distance between the middle line to the great trochanter looks larger on the diseased than on the sound side; the rima natium slopes from below upward and toward the unsound side. If an attempt be made to correct this position—to make the child stand in drill posture (knees straight and feet together)—he will go through many contortions in the endeavor; he will, if he can bring the feet together at all, bend the knee (affected side). If he be told to straighten that joint, he will rise on the toes of the sound side, and by rotating backward the affected side of the pelvis protrude that buttock. All this is to gain length between the acetabulum and the floor without altering the angle between the femur and innominate bone; also to avoid putting any weight on the diseased limb. Moreover, though he may stand tolerably firm and still, with advanced foot, as in the first described posture, he will, when a different position is forced on him, be constantly losing his balance, swaying about, and grasping at any neighboring object for support. In whatever attitude he may stand, the surgeon will find, by placing his hand on the two crista ilii, that the one lies considerably lower than the other, and that the spine curves, *i.e.*, is convex, toward that side. Sometimes such patients will not stand at all, but simply cower, cringe, and scream; it is better then to trust to investigation in the recumbent position.

Fig. 56.—Left hip disease—lengthening.

If the stage of disease be that of shortening, the appearances are in almost every point the direct contrary of those just described: the weight of the body is supported on the sound limb, the other rests on the toes; the heel drawn up, the knee is but very little, or not all, advanced, but lies higher, often a good deal higher, that the other. Although the diseased lies parallel, or nearly parallel, with the sound thigh, yet it is considerably flexed, as marked by the horizontal position upon it of the pelvis, and the protrusion backward of the buttock; the lumbar spine therefore has a considerable forward bend[1] (lordosis). The crista ilii of the diseased side is considerably higher than the other, hence the spine is concave in that direction, and the rima natium slopes from below upward and away from the affected side. The foot is commonly inverted, but not to an extreme degree.

The examination in recumbency is less easy, unless the case be pretty

[1] For cause of this backward projection, see p. 298.

strongly marked, and the surgeon may often feel doubtful as to the existence or non-existence of a slight degree of lengthening. The difficulty lies in getting the mesial line of the body and the interval between the legs in a straight line. The shortest and readiest way of determining this point, is to go to the bottom of the couch, and holding the patient's feet so that the inner malleoli and heads of the inner metatarsal bones touch, to look between the two insteps along the body, and see that the gap between the knees, the centre of the pubes, the umbilicus, xiphoid cartilage, and middle of the fossa at the root of the neck are all in a straight line. If they be so, or can be brought so, the apparent lengthening will easily be determined by examining the relative position of the two inner malleoli. Such an examination is always permissible in a young child or in the youth. Difficulties arise if the patient be a female beyond the age of childhood, but nothing must prevent such investigation as shall lead to correct diagnosis; we may either proceed in the manner just described, covering the pubes with a handkerchief, or a less unpleasant mode of examination may be employed. Thus, a cord may be held in the centre of the episternal notch, and, passing under the chemise, run between the malleoli, when, by investigating if it bisect the xiphoid cartilage, the umbilicus, and lie between the knees, the surgeon may secure straight position with but little exposure of the body. The relative height of the internal malleoli will then reveal lengthening or shortening.

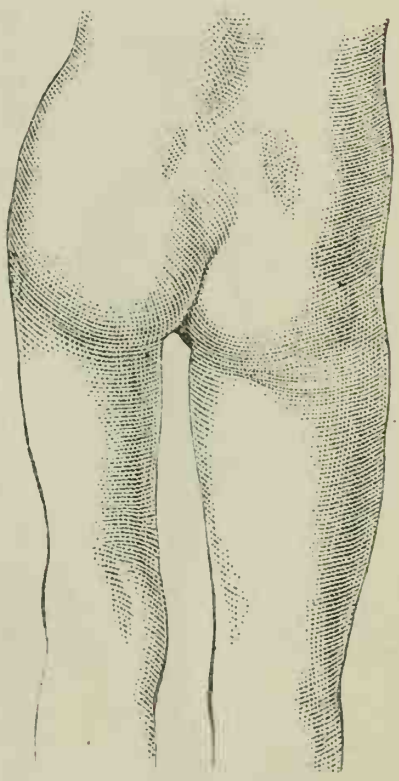

Fig. 57.—Left hip disease—shortening.

If in spite of shifting the limbs and pelvis, or shoulders and chest from side to side upon the bed, the body cannot be brought straight with the limbs, there is something amiss; in all probability this something is pelvic obliquity. To ascertain that point, if necessary, the abdomen from above the xiphoid cartilage to near the pubes must be uncovered. The abdominal raphe, generally sufficiently plain, will be seen curving toward the side of lengthening,[1] and a line drawn from one anterior iliac spine to the other will be oblique with the general mesial line of the body. Or another way: let the patient place and grip between her knees a cord, the other end of which she must hold on the xiphoid cartilage. This cord forms a straight line, but if the pelvis be oblique, *i.e.*, depressed on the right side for instance, the umbilicus will be on the right of the straight line. Now the surgeon should take another cord and stretch it between the two anterior iliac spines; if the pelvis be straight, this second piece will cross the first at right angles, not so if obliquity exist. There are, of course, four angles at the cross: we will call those, that lie below the second tape, iliac angles. Now the iliac angle on the side of lengthening will be acute, that on the side of shortening obtuse. Having gained all necessary information by one

[1] I cannot say diseased side, because I am explaining the examination both for lengthening and shortening. The curve will always be convex toward that side on which the pelvis is depressed, concave toward that on which it is rasied.

or more of the means above described, the surgeon should compare also the relative height of the inner malleoli or of the knee. Such minute investigation is, of course, only necessary when the symptoms are not well marked: in a large proportion of cases, especially if the patient be an infant, the posture is quite characteristic, as for instance in Fig. 61.

Certain writers speak of causing the patient to sit on a chair with the knees bent, and observing if one of those joints project beyond the other. That which has been (p. 284) and will be said below about fixity of the thigh proves beyond doubt that no patient with hip disease can so bend or straighten the thigh as either to stand or to sit "fair and square." Observation will show any one, who studies these conditions, that such a patient, when attempting to sit, so slews and screws the pelvis, that the limb which is lengthened or shortened in standing may appear either unaltered or in an opposite ratio, during the posture assumed to imitate sitting. Any result from such method, though it may occasionally come right, is entirely unreliable.

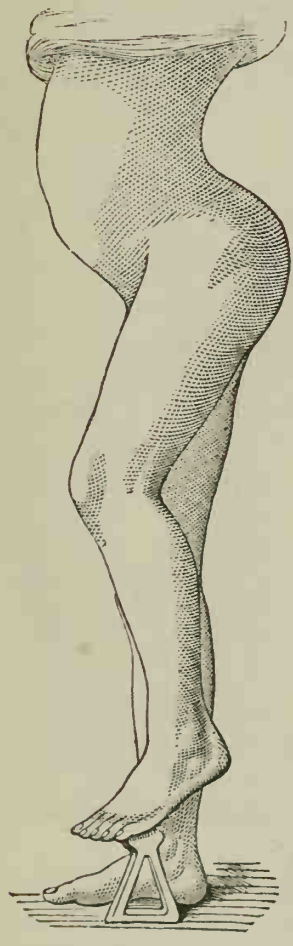

FIG. 58.—Flexion with shortening.

It is well to remember that in some persons one leg, usually the right, is without disease longer than the other by mere unevenness of growth.[1] This may occur at a very early age. Quite recently Dr. Craske Webb, of Lower Belgrave Street, brought me a little girl, only five years old, whose right limb was $1\frac{6}{8}$ inch longer than the left. If such cases be examined erect, one finds that there is no difficulty in standing with the feet together and the knees straight, while in such posture the crista ilii on the lengthened side lies *higher* than the other; the contrary is the case in hip disease. If the amount of deformity cause, to him not yet experienced in such cases, any doubt, let him place a block or book under the shortened limb, and the deformity will disappear, or, if the book be too thick, will be reversed. It has never been my fortune to meet with a combination of hip disease and unilateral overgrowth; no doubt it might cause some difficulty of diagnosis.

Certain other positions obtain throughout the stages of lengthening and shortening; the chief of these is flexion—a bending of the thigh on the abdomen at a definite angle: a certain difficulty of detection lies in the fact that the patient will not alter this angle. My reader will remember that even in the initial phase of the disease the patient follows with the pelvis every movement of the thigh, so as to avoid motion of the caput femoris within the acetabulum (p. 294), and that both lengthening and shortening depend upon the persistent maintenance of a certain lateral angle between thigh and pelvis: the various postures which result from flexion are to be explained from the retention of an antero-posterior angle. The thigh then has assumed, with the pelvis, a certain antero-posterior angle, as shown in Fig. 53, *a*, *c*, *e*. The patient cannot stand with the limb lifted in the air; he is obliged, or is told, to put the leg down. He effects this without chang-

[1] For fuller description, see my work On Lateral Curvature of the Spine.

ing the angle by flexing the pelvis on the spine, by placing it almost horizontally (Fig. 54), so that the posterior surface of the sacrum looks almost directly upward. Fig. 54 is the skeleton; Fig. 58, a patient photographed in this posture. The left thigh cannot be brought quite parallel to the other, the knee is bent, the buttock is thrown back and protrudes, the upper part of the abdomen, with the lower ribs, thrust forward. To maintain balance, the patient has to throw the chest and shoulders back, therefore, to bend the lumbar spine with a sharp anterior curve (lordosis).

The surgeon should know, lest he be misled, some peculiar effects of this posture on the recumbent patient, who will probably keep the affected knee raised from the mattress; yet if told to place it on the bed by the side of the other, will very likely comply with so little trouble that the unwary

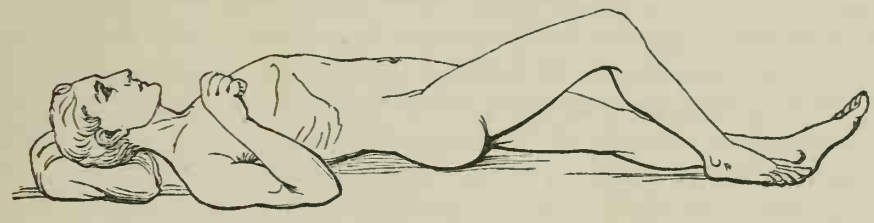

FIG. 59.[1]

might conclude on the absence of hip disease. This mistake may be avoided by examining the position of the loins. When a patient with flexed thigh obeys his surgeon and lays the limb down flat on the bed, he does not alter the angle between pelvis and femur, he simply allows the former to rise as the latter falls, until it comes to lie almost perpendicularly on the couch. To effect this a sharp bend of the loins must be produced, which the surgeon can instantly detect by passing his hand beneath them (Fig. 60).

Flexion of this sort is very nearly always combined with the posture of lengthening, but is less marked than in the stage of shortening. In consideration of the great importance of fully understanding these conditions, I will

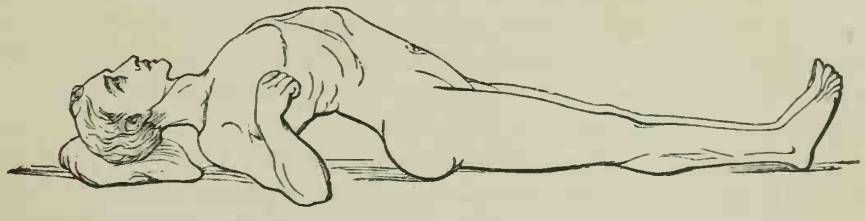

FIG. 60.

not apologize for the great length at which I have felt necessary to explain shortening, lengthening, and flexion, which, with the cognate twists of pelvis and of spine, we will class together under the term "posture symptoms."

We will return to the second phase of the disease, that of lengthening, and consider the other symptoms of that stage: these are, wasting of the limb; pains in different places and of different kinds; swelling in certain localities, not unfrequently the commencement of abscess.

Wasting of the limb in other joint maladies has been fully discussed; it is in hip disease the same process, and is easily detected by the eye or veri-

[1] By turning the book sideways these figures can be made to do duty also for erect position.

fied by measurement. A form of wasting, however—that about the nates—may be specially mentioned, as helping to give the flaccid, inert look to this part so characteristic of the second stage.

Pain and tenderness, though they make their appearance in the first stage, and have been already mentioned, belong more especially to this phase of the malady. Tenderness and pain are often so interwoven, that the mode of looking for the one is, in general, identical with the search for the other. Yet one kind of joint-tenderness is more distinct. It may be evoked by movement, or by pressure of one joint-surface on the other. The movement most likely to call forth pain, is that which normally is most restricted, namely, inward rotation, and, next to that, abduction. I cannot too strongly recommend the greatest gentleness and caution in putting a patient to these tests—indeed, unless strongly called for by uncertainty of diagnosis, they had better be omitted altogether. The same may be said of all modes of knocking or pressing the joint-surfaces together. The rather rough test, used freely by our ancestors, namely, jerking the femur up into the acetabulum, should only be employed when the fullest investigation has pretty surely shown the absence of hip disease. Sometimes, even when morbus coxæ in a very early stage is undoubtedly present, this action, or pressing the trochanter inward, will fail to produce any pain; traction of the thigh downward will then generally succeed in doing so.

The pains of hip disease are manifold. Such sensations, however, as the burning or gnawing in the joint itself, being common to this and to other articular disease, need not detain us; but the hip has certain pains peculiar to itself, especially that at the knee and front of the thigh, whose etiology in connection with muscular contractions has already been considered. The knee-pain is sometimes remittent, sometimes constant; it may be absent for hours, and then return with a sudden stab, which makes the patient start, even perhaps scream. It occasionally commences before this second stage comes on; but even then it gets worse at this time, so that it is more especially a symptom of this and the subsequent period of the disease. When it occurs early in the case—for instance, before lengthening has commenced—it occasionally leads diagnosis astray. I have not unfrequently seen cases of hip-joint disease, in which blisters and other treatment had been applied to the knee. It is necessary, therefore, to guard against a too confident diagnosis without sufficient examination, more particularly as the chief seat of pain in knee-joint disease corresponds pretty closely with the spot usually painful in morbus coxarius.

The most certain modes of distinguishing the knee-pains of hip disease from the pain of knee-joint disease are these: pains resulting from propagation of sensations along the bone are relieved by strong pressure on the condyles with the palms if the limb be not moved; and pains from nervous irritation, if not relieved by such means, are, at all events, not aggravated. The contrary effect follows pressure in knee-joint disease. There is, however severe they may be, something peculiarly vague and uncertain about the seat of sympathetic bone-pains. In pointing out their locality the patient lets his finger wander. A nerve-pain derived from an irritation higher up the trunk is not thus diffused; it must of necessity be situated in, or run along, the track of the nerve. In early stages of hip disease, before muscular contraction comes on, flexion or extension of the knee is painless, if the thigh be kept still. When hip disease has reached the point of knee-pain, the mode of investigation described at p. 294, will *always* detect some rigidity of the hip-joint.

The pain has been said to be of a remittent character. This is gener-

ally, but not always the case ; sometimes the remissions are quite free, sometimes not so. When the intervals are not free, it is observed that the periodic pain gradually assumes a different character, until, in the latter part of this stage, it quite overrides and conceals the ordinary aching in the knee, and yet, while still not very severe, mingles with, and for the moment takes the place of the other. The intensity of these latter nightly pains is very variable in the period of lengthening, but is never so severe as during the next stage—that of shortening. Moreover, when their severity during the second phase greatly increases, we may confidently expect that the third period is about to commence. The pain is of the same class as the starting-pains of other joints, but is much more intensely developed. Thus the gnawing sensation which is connected with inflammatory conditions about the sub-articular cancelli, represents the interval not, however, quite free ; but these conditions are always accompanied by spastic contractions of muscles, which, driving the inflamed head of the bone upward against the carious acetabulum, gives rise to a sharp stab of pain, which causes the child to start, to moan, or, in the more developed forms, to shriek. Such spasms, if they occur in the second phase of the disease, soon culminate in that more advanced form of contraction, which marks the third stage.

Tumefaction generally begins, during the period of lengthening, to be more pronounced than it was in the earlier phases, though I have seen one or two cases in which swelling, previously considerable, began to subside when the second phase had fairly set in. This symptom is usually, though not always, preceded by a rise of temperature ; not one of those transitory jumps of the mercury which is with children so often meaningless, but a continuous rise up to 100° or 101° in the morning, even to 102° in the evening. This is very often accompanied by pain. The swelling may be either hard or soft, it may make its appearance in the upper part of the thigh, behind the trochanter, below the groin, beside the perineum, and in the iliac fossa. General enlargement of the upper part of thigh is usually accompanied by pretty distinct marking of the veins under the skin ; or, where this is not the case, the skin becomes thick and rough. The swelling does not occupy the whole upper third of the thigh, but ceases at a level a little below that of the perineum. It is to touch rather soft and doughy, yet seems deep. It indicates the commencement or immediate advent of suppuration, especially if the superficial veins be enlarged, and if there be some œdema.

The swelling, which is often found behind the trochanter, is generally accompanied by a like enlargement at that triangular space below Poupart's ligament, which is included between the outer and inner margins respectively of the ilio-psoas and of the pectineus. Just here the head of the bone, though pretty deep, is not much covered, so that the surgeon's finger deeply pressed comes near the capsule of the joint. We can examine for fluctuation from one of these parts to the other, from this spot to behind the trochanter. Such fluctuation is, however, rarely found. Another mode of examination, which I have for years been teaching to my classes, generally affords more information than palpation of each locality singly. The surgeon, stooping over, or, if necessary, kneeling with one knee on the bed, so as to get well in front of the patient's pelvis, places the fingers of each hand deeply on the post-trochanteric fossæ, the thumbs on the sub-pubal space just indicated. By pressing thumb and fingers together he grips between them the femoral neck, and some portion of the head. Moreover, having these parts on both sides simultaneously under inspection, he can perfectly compare one with the other. In some cases he will find soft swell-

ing, but in the majority of instances the tumefaction is so hard and so considerable, that it conveys an impression of the bone being enlarged by one-half, or sometimes as though its size were doubled. The sensation is well-marked and unmistakable. The more one grips and isolates this portion of bone, the more distinctly and evidently does this enlargement manifest itself to the touch. In such cases the spot near the perineum, so often referred to, just outside the ramus of the pubes, and behind the adductor longus tendon, will often be found swollen, even before tumefaction behind the trochanter and on the groin can be verified. Another spot where swelling not unfrequently occurs is the iliac fossa and the pectineal line, examination of which should never be omitted. If the child have sluggish and flatulent bowels, enlarged mesenteric glands, or be unusually fat, the investigation is a little difficult; yet these impediments can with art be overcome or eliminated. The surgeon, making his patient lie supine, and a little turned on to the sound side, having both thighs and trunk a little flexed, places his hand on the sartorial notch, glides it with the integuments inward, lets it sink into the flank, pushing the bowels toward the middle line by a rubbing and kneading motion. When by these manœuvres he has got the finger-tips deep enough, he directs them outward, and will at once feel the iliac fossa, and should, if possible, also detect the ilio-pectineal line. Now, most cases of hip disease—all those that begin about the femur or synovial membrane—present at this point nothing abnormal; but in the pelvic form of the disease (and occasionally in later stages in any form of the malady) a well-marked lump is very evident; it feels conical, its base toward the ilium, its rounded apex projecting inward; it appears to spring not merely from the lower border of the venter ilii, but also to merge out of the true pelvis, obscuring its brim at the point of growth. (See p. 279, and Fig. 48.)

Lest the somewhat minute description of these symptoms may have obscured a general view of the subject, it will be well to recapitulate.

First stage.—Limping, sometimes intermittent, sometimes persistent. Joint-tenderness. Pain at the knee, in thigh, or over the dorsum ilii. Fixity of the Joint.

Second stage.—Lengthening (apparent). Flexion. Wasting of Limb.—More pronounced pain at the Knee.—Starting-pain.—Swelling at different parts.—Formation of Abscess (occasionally).

These symptoms, both of the first and second stage, certify the presence of hip disease. But they do more than this if properly used; if the method of study and examination inculcated in the last few pages have been duly adhered to, the facts elicited will indicate with considerable precision, both in the first and second stages, the seat of primary disease, whether, namely, it be in the pelvis, in the femur, or in the synovial membrane. To facilitate the comprehension and utilization of these phenomena for differential diagnoses, I will place them in a tabular form.

The second stage of morbus coxarius, whatever be its original seat, lasts an indefinite time. It is in certain cases, and in the more acute forms of disease, very transitory, while it may continue for months in chronic cases carefully treated—the patient may, indeed, recover in this stage. The symptoms slowly subsiding, pain and spasm will cease, joint-tenderness disappear, shortening never making its appearance. A certain amount of stiffness and of fixity will remain, commensurate with the duration of the case. The chief fixity is in the direction of inward rotation and of abduction. Hence in many cases apparent lengthening will survive a long time after all disease has ceased—may, indeed, require to be overcome by treatment.

	Synovitic.	Femoral.	Pelvic.
Mode of limping.....	Dragging of the limb, which is slowly and badly lifted; less marked in the morning. strongly marked in evening or after exercise. Patient will bear his weight on limb pretty well with little complaint.	Foot not dragged—not advanced in front of other—stands on it as short a time as possible, bringing sound one forward very quickly; body swung over to diseased side. If made to put weight on limb complains much.	Foot advanced a little before sound one; when weight comes on it body thrown to sound side; apparently great sense of insecurity, and patient often refuses to put weight on diseased limb. rather it seems from fear than pain.
Posture symptoms.....	Lengthening comes on very early, is marked and lasts a considerable time. Shortening occurring soon after starting-pains.	Lengthening does not commence till after joint-fixity has lasted some time; it is succeeded rapidly by shortening. Mal-posture strongly marked.	Posture symptoms not well marked; sometimes lengthening goes on throughout; more rarely there is neither lengthening nor shortening.
Knee-pain.....	Early at internal condyle, indefinite knee-pain absent, or much later.	Early indefinite knee-pain, inner condyle pain late.	Either no knee-pain at all, or it comes on very late at inner condyle.
Starting.....	A late symptom.	Early symptom.	Absent or very late.
Other pains.....	Referred to upper part front and outside thigh, and behind trochanter. Patient sleeps part of night on diseased side.	Patient looks worn before or soon after advent of pain, especially in the morning; pain referred to knee and to part beside perinæum, rarely to groin; sleeps on back or sound side.	Pain about anterior inferior spine and dorsum of ilium; not severe but constant. Patient has a very worn look generally.
Swelling.....	Soft swelling is visible behind trochanter and in lower groin. On gripping firmly head and neck of bone, the feeling of tumefaction is doubtful.	Hard swelling. On gripping head and neck of bone it is plainly felt, but is rarely visible. Glands of groin enlarged.	No swelling behind trochanter and in groin. Swelling in iliac fossa.

Third Stage.—More commonly when the phase of lengthening has lasted a certain time, aggravation of the symptoms marks the advent of the third stage. If the child wake more frequently with more pronounced and sudden starting, shortening is imminent; if he, left to choose his own posture, lie on the sound side a little inclined to the prone position, cross the affected limb over the other, letting it rest on the inner condyle, the third phase has already commenced. He may be constrained to lie on the back, and the limb may be fixed, yet if we detect a constant tendency to bend the trunk toward the sound side, the shoulders and chest always getting to that edge of the bed, we may be sure that shortening has set in. The change from the one phase to the other often appears to us sudden. We find on some given visit that a limb, which formerly has appeared lengthened, has assumed a shortened aspect.

The annexed plate represents the appearance of shortening in a recumbent infant, with the usual enlargement at the upper part of the thigh, and the peculiar oblique posture of the pelvis. The twisted bend of the loins shows that, although the limb lies flat on the bed, flexion is also present. I will complete the description of this phase by showing the same condition in the erect posture. Shortening had in this latter case been present for about six months. The flaccid condition of left buttock, the broadening of the nates, are well marked, while the further backward protrusion of that side of the pelvis is the sign in this view of flexion. The limb is much wasted.

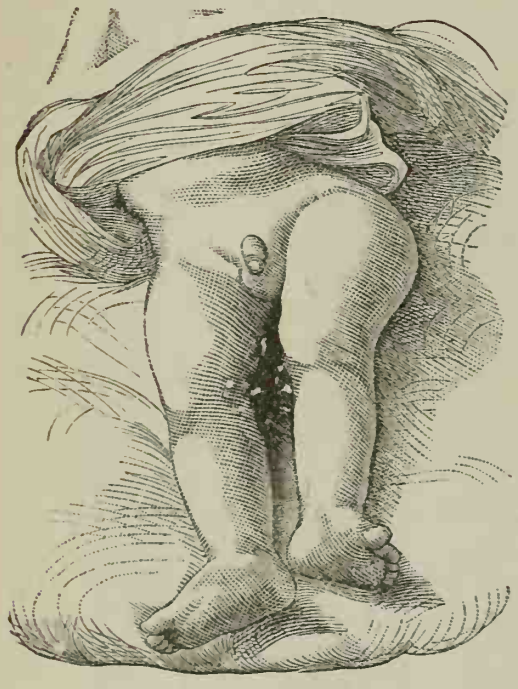

Fig. 61.—Third stage of hip disease.

Later still, that is to say, when diseased action has ceased, unless anchylosis take place, certain modifications in the posture become very apparent. Flexion yields considerably to muscular effort, the thigh regains some of its normal size (the sound one is abnormally developed), but the pelvis remains permanently oblique; *i.e.*, the limb on the diseased side is considerably adducted. This position gives rise to projection of the trochanter major, aided, however, by the fact that the bone lies higher on the pelvis, being, nevertheless, still in the acetabulum.

In nearly every case (unless very acute), just after the advent of shortening, a period of alleviation sets in. This may last only a few days, may continue some months, and may be permanent. Indeed, of all cases of hip disease which recover, the greater number do so at this particular phase. This recovery may be interrupted by intervals of exacerbation—even of threatened abscess. Such instances of irregular improvement, of convalescence, *per saltum*, form the transition between such as get well and such as get worse. One mode of getting worse is by increased ulceration and suppuration at the seat of caries, accompanied by abscess in the neighborhood. The symptoms which mark the formation of abscess are often obscure, locally often *nil;* for it will readily be understood that, while advanced ab-

scess and large quantities of pus may be readily found, a small quantity of matter, covered in by such dense and thick structures as lie about the hip, buttock, and upper thigh can hardly be detected by any local signs. If the abscess form slowly, as a mere continuation and natural accompaniment of the caries, not in itself aggravated, no additional pyrexia, increase of pain, or starting, appears. If, on the other hand, abscess is a direct result of exacerbation, many manifestations mark its formation: rigors occur only if the abscess is very acute; commonly a certain rise of temperature, most marked in the evening, increased starting, languor, a somewhat furred

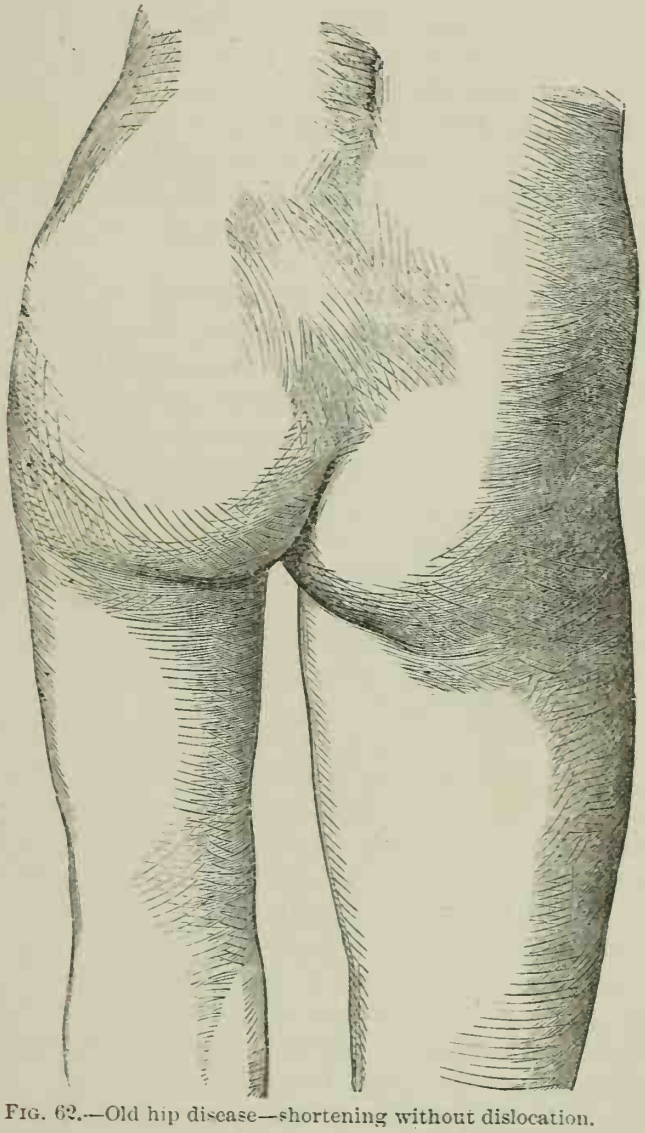

FIG. 62.—Old hip disease—shortening without dislocation.

tongue, are the systemic signs; the local ones being increased tumefaction about the trochanter, or in the upper fourth of the thigh, with sometimes a glazing of the skin, and evident marking of meandering surface-veins, a greater distinctness to touch of the lymphatic glands of the groin, either by actual enlargement or by being pressed forward from below; sometimes unusual forms of pain along the nerve-trunks accompany these other phenomena,[1] all of which are rarely simultaneously present.

[1] In one case which occurred to me in 1869, the patient, suffering from recent suppuration, endeavored to get relief by constantly nipping between the fingers a thick fold of soft parts about the middle of the outer aspect of the thigh.

The place at which abscess may point is very various, depending in part on the effect of position and of gravity, in part on the disposition of fasciæ, etc., and very much on the place where pus has first caused rupture of the capsule, or if extra-articular, where it has first formed.[1] A common place at which fluctuation may early be detected is behind the trochanter; but it must be remembered that sub-gluteal abscess and that caused by sacro-iliac disease commonly appears there. Pus may also first manifest itself on the inner or on the outer aspect of the thigh, sometimes, indeed—especially if the patient have been a good deal in the erect position—very far down the limb. Abscess pointing or opening between Poupart's ligament and the body of the pubes, unless merely glandular, is nearly, if not quite always, intra-pelvic, and almost invariably a result of morbus coxæ, though, in rare cases, it may be connected with sacro-iliac disease.[2] Intra-pelvic abscess from hip disease may also, in the recumbent posture of the patient, gravitate backward, and may pass through the sacro-sciatic foramen, and appear behind the trochanter, or, if it be below the ilio-pectineal line, may point at the posterior margin of the anus or vagina, or may even burst into either of those tubes.

When an abscess has burst it may occasionally be possible to pass a probe into the joint, and there detect carious bone. But this can rarely be effected even when Sayer's vertebrated probe is used, and for these reasons. The abscess is often peri-articular, and does not communicate with the joint—or that form of abscess may have some communication with the articular cavity—but the pus has always, before pointing, formed a large space around and about the capsule, the opening into which is very small; a probe passed into such an abscess will wander freely about its walls and the ligament, and can hardly ever hit on the little opening, which indeed, may be on one aspect of the capsule, while the skin opening will be on the opposite one. A probe, properly bent, passed into a groin sinus, connected with intra-pelvic abscess from hip disease, will often impinge on caries or necrosis on the pelvic wall of the acetabulum.

A patient in this condition, viz., with an adducted and shortened limb, one or more abscess-openings, pain more or less severe, pyrexia and perhaps general wasting, may, nevertheless, under careful management, recover—with, of course, a considerable amount of lameness; but on the other hand, the local malady may so affect his nutritive and assimilative functions as to induce disease of the thoracic or abdominal viscera, leading to lingering death. Thus devolves upon the surgeon the duty, in many cases the extremely difficult duty, of accurately weighing the tendency to the former or to the latter event. He must, as in other cases of joint disease, watch the direction of the symptoms, whether to improvement or the reverse; the thermometer, the excretions, condition of the skin, etc., must all be questioned at certain periodical visits, so that the general trend of the malady through a certain period may be accurately studied.[3] Besides this he must gain as accurate a knowledge as possible of the extent and condition of the

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[1] Occasionally the spot of manifestation cannot thus be accounted for. I lately had a patient under my care who had a large, very slowly formed abscess in the front of the thigh, outside and a little below the origin of the rectus. The diseased part of the bone was the lower and inner part of the epiphysal junction, exactly that form of affection whose abscess usually appears on the inner aspect of the thigh.

[2] Psoas abscess from spinal caries points internal to and below this spot, yet in one case of disease of the lower lumbar vertebræ I found an abscess fluctuating over the situation of the anterior crural nerve.

[3] This subject is more fully discussed in Chapter XX.

local disease. At the stage now under consideration, the limb is wasted, adducted, shortened; abscess, opened or not, is evident. More than this we cannot make out, without producing intolerable pain, and probably some injury, unless an anæsthetic be administered. When complete unconsciousness has been produced, the thigh will be much more movable on the pelvis, although abduction, extension, and outward rotation, more especially if the third stage have lasted some time, are very limited. I would caution my readers, however, against using any rough handling or excessive movement of the limb, even in those directions in which it seems most easy, but especially in those which are difficult. Absence of pain is not synonymous with immunity from injury. Our object is to find out if motion within the restricted limits be smooth and facile, if it be rough, jolting, or grating.[1] This is done by grasping the neck and head of the bone between the fingers and thumb of one hand and with the other moving the limb cautiously and gently in its various directions, it may also be drawn down or pushed upward. We should take the opportunity of determining the position of the head of the femur, in reference both to the shaft and of the pelvis; the projection of the trochanter, its mode and amount should also be clearly made out. During this period of unconsciousness, abscess, if still closed, may be opened antiseptically, and through the orifice, or, if a sinus already exist, then through its mouth a probe may be passed, the condition more fully made out, than under other circumstances is possible. Indeed, if the probe do not give much information, and the abscess around the joint be capacious, it will be desirable to enlarge (antiseptically) the skin opening and to introduce the finger into the cavity. This finger, used with great caution, lies close to or upon the capsular ligament, and may often detect a little opening in it, to which a probe may be guided; or it may more readily detect the grating of diseased bone-surfaces, or may feel the upper edge of the displaced acetabulum, rough, uneven, and soft; or again, if, without the slightest force, it can be insinuated under the neck of the femur, it may detect the same osseous conditions about the epiphysal junction. I do not, by any means, intend to say that such wide-spread researches are desirable in every case, nor indeed in the generality of cases; but they are all feasible without injury to the patient; when the propriety of operative interference is in question, and cannot be otherwise decided, they are not merely justifiable, but absolutely demanded. Each practitioner must, in each individual case, judge where his investigation may stop; he who has had a wide and careful experience, will often be fully instructed by a minor research, but will also, in difficult cases, know the value of a thorough examination.

The surgeon is often asked whether or not the bone is dislocated; occasionally there may be a little difficulty in answering this question, but in my opinion that difficulty is greatly exaggerated. There is no doubt that pathologic dislocation does take place, and even is not very unfrequent, but it is much more common in acute than in chronic hip disease. The patient suffers for a period, usually less than ten days, from very severe pain and pyrexia, the limb rapidly assumes the position of shortening, then almost suddenly the pain and the fever greatly abate, but shortening continues. In a little time all the severe symptoms disappear, but the patient is lamed by great shortening and extreme fixity of limb. Rarely, after the first amelioration, the symptoms recur: even suppuration may supervene. In the former set of cases, if we examine the patient lying supine, the crista

[1] See p. 115 on the presence and absence of grating.

ilii will be found on the same level, the line running from one to the other is at right angles to the axis of the trunk (see p. 296). Nevertheless, the limb is from one and a half to two inches short. To the practised eye, this straight position of the pelvis, in combination with shortening, reveals at once luxation. In the second category the pelvis is oblique, as in the posture of apparent shortening—a line from the anterior superior iliac spine of the sound side drawn across the abdomen, at right angles to a line between the umbilicus and centre of the pubes, will strike the opposite ilium at a certain distance below the upper spine of the unsound side; this distance can be measured and compared with the difference between the height of the knees or malleoli. If the one measurement be an inch, or at most an inch and a half, the other from two and a half to three inches, or even more, according to the size of the child, dislocation is certainly present. It is, however, always well to check these observations by making use of Nélaton's line; this is done by placing the patient on the sound side, finding the middle part of the tuber ischii, and laying a tape between that spot and the anterior superior iliac spine. Then the finger is drawn with deep pressure along the upper margin of the tape, about its centre, until the great trochanter is plainly felt; if this be considerably above the tape-line there is dislocation (the above appearances agreeing). A slight elevation of this process—especially if the case have been a chronic one—does not indicate luxation, but upward travelling of the acetabulum and absorption of the cervix femoris. The posture of the limb as to inversion and adduction varies considerably; in pathologic dislocation, if the case have been acute, both these postures are strongly marked, but if chronic, are far less patent, owing to the absence, total or partial, of the femoral head and neck. In such cases, too, the limb is not so rigidly fixed. Diastasis, as separation of the epiphysal head is called, is characterized by extreme shortening and considerable mobility—with very little posture symptoms (inversion and adduction). The mobility is especially marked in the downward direction; the thigh may, by traction, be drawn down till it is equal in length to the other, and this without moving the pelvis. When released it may even remain in that place, or be very slightly retracted. Pressure upward at the sole of the foot will shorten the limb again, or in many cases the recumbent patient can voluntarily abbreviate a limb that has previously been pulled down. In either case the surgeon can feel the trochanter moving upon the ilium. No patient can by effort lengthen the limb; a few can bear some weight on it, but if they walk, it gets shorter and shorter, more and more unreliable, and at last utterly useless.

A large number of cases of hip disease recover without dislocation or diastasis, after the stage of shortening has lasted some time. The recovery is generally intermittent; pain returns a few weeks after the child has been getting about, and he is put to bed again. Abscess may break out afresh; from such relapse the sufferer may never arise. On the other hand, all these signs may disappear, and again recur. I have known abscess to recur twenty-three years after the apparent final recovery. Now, a patient thus recovered is lame exactly in proportion to the amount of adduction (shortening) and flexion of the thigh. If they be extreme, the position forced upon the spine so deforms the trunk, that many such persons are terrible cripples and become more and more distorted as time goes on. Of course the thigh is not merely adducted and flexed, but is also fixed in this faulty posture; the fixation is generally by false anchylosis, and then always in part also muscular, less often by true anchylosis. It is important to distinguish between the two latter conditions. It may be done in two

ways—the one by giving chloroform, and endeavoring to find if any movement between femur and pelvis can be produced—the other by examination without chloroform. In either case, unless the patient be a child, two persons are necessary; one must fix the pelvis, the other (if the patient be in narcosis), endeavors to move the thigh watching the angle. The method by itself is not very efficient. It may, however, be used to supplement the other mode, which is to let the patient's muscles tell us the condition of joint. If when the pelvis is fixed, the surgeon try by a sharp, but not violent, jerk, to adduct the limb, the adductors, especially the long one, will twitch if the anchylosis be false, and will remain quiescent if it be true. (See Chapter XVIII.)

Treatment.—A hospital surgeon, especially if his institution have a children's ward, sees only too much of hip disease, as an all but incurable complaint; simply because the patients are so very generally brought when the joint is already in part disorganized. Such children have very likely been limping more or less about the streets for months; perhaps even they have been ordered to be kept at rest and in bed; they may have been so treated for a week or two, when both child and parent get tired of the restraint. There appears to be not much the matter, and the little one is sent out to walk or play as he wills; and at last he is brought to the hospital with a lengthened or shortened limb, limping decidedly, or unable to put foot to the ground.

But in private practice we see cases under different circumstances. A careful nurse or mother will have seen some disquieting symptoms, a little stiffness, a slight change of gait, from the very first. The surgeon consulted makes out, by the mode of examination described at p. 294, the earliest appearance of disease. I doubt, as already said, whether at this period the joint itself, *i.e.*, the synovial membrane and cartilages (the wall of the joint-sac) is affected. However that may be, there is no doubt that a large proportion of children having only got thus far may be saved the further steps of the disease. This depends in part on the patient's constitution, in part on the means employed, and in part on the docility and patience of attendants and child.

A considerable difficulty as to the first means to be employed encounters the surgeon; for to lay up in bed a child, who has but a little hyperæmia about the upper end of the thigh, may, by breaking down the health, conduce rather to prolong or intensify the disease; while it is much more feasible to altogether forbid to a child any movement, than to limit his exercise within prudent bounds. If, then, the fixity of thigh be but slight—*i.e.*, a certain though limited range of movement within the acetabulum be easy and painless—we may let the child sit up, be carried from room to room, and in the summer let him sit or lie in the garden, or drive out with the lower limbs supported by a cushioned board; but walking must be forbidden, especially up and down stairs. If the thigh-fixity be more than this, he must be kept recumbent, and the thigh to a great extent immobilized. Yet there are some other matters besides the local condition to consider, viz., the child's general health, his more active or more quiet temperament, and the possibility of keeping him (for he is neither ill nor suffering) for a long time thus still. Hence some relief to severe restraint may be still given by letting him go out recumbent in a properly constructed invalid-carriage; or, if still small, in a well-arranged perambulator, or he may be amused in a swing. In the country a couch in the garden or on the beach may be arranged. To play in the house—and many children will not or cannot play while lying on the back—he may have a

couch for prone recumbency, consisting of a horizontal part, on which his trunk and toys are to lie, and a sloping part for the lower limbs. From the one to the other of these resting-places he must be carried; but at night a certain amount of immobilization and probably extension will be desirable; and thus, while affording proper rest and treatment, we may relieve the monotony and irksomeness, the want of change of air and scene, which have often very much to do with inducing a languor and inaction not conducive to recovery from sluggish disease.

In the meantime such internal remedies as have been mentioned at pp. 119 and 238 may be administered, and some counter-irritant, as epispastic fluid or paper, nitrate of silver lotion, etc., is to be applied alternately to the groin and behind the trochanter, taking care not to raise a blister.

The amount of liberty allowed must be watched, and if the thigh-stiffness at any time become more pronounced, a less indulgent system must be enforced, especially must pain be taken as a sign that more vigorous treatment is needed. The advent of decided limping, or of lengthening, marking the second stage, are even stronger warnings.

Sometimes, however, even in the earliest phase of hip disease, or at least in the earliest at which we see it, no such liberty as above described can be permitted. In all cases, for instance, in which we find pain, either about the knee or in the neighborhood of the hip; whenever thigh-fixity is such as to permit but a very slight or no movement in the acetabulum; whenever there is any tendency to start; whenever, in walking, the foot of the diseased side keeps behind that of the sound one, and the rhythm of the gait is in dotted notes, complete rest is needed. Some surgeons, indeed, put an appliance (Thomas's splint) on the diseased, a high shoe on the sound side, and let the child go about with crutches. I shall have occasion to refer to this treatment by-and-by, therefore will only say at present that when the symptoms are as severe as just described, they should first be subdued by a more complete rest. With this rest extension ought to be combined. It does not matter whether the limb is apparently lengthened or apparently shortened, the treatment is not designed to have any effect on this posture. At p. 280 I have described the effect of pressure produced by muscular contraction, how it forces the femoral head against the acetabulum, in a direction chiefly upward, and how, wherever the malady may have originated, we always find this part of the joint eroded. To prevent this pressure, or at least to mitigate its effect, is the object of extension.

But we do not always have the opportunity of thus watching cases from their commencement. On the contrary, we are not unfrequently called to children who, after a certain amount of suffering and limping, are somewhat abruptly attacked by severe pains and entire inability to use the limb. We find the patient with the thigh sharply flexed on the abdomen—dreading contact and screaming at any attempt at examination. If such case be permitted to continue in such posture the result is days and nights of severe suffering, continued perhaps for a fortnight or more, accompanied or followed by rapid abscess, destruction of the joint, and not improbably combined with dislocation. Entire ease, or at least great relief, may at once be given; perhaps even, as has happened to me more than once, the joint may be saved by restoration of position. This often requires no exercise of force. The patient lying on the back holds the thigh flexed against gravity. Under the influence of ether, as consciousness slowly ceases, so, as a rule, does the thigh sink down until it lies upon the bed straight by the side of the other. Or if it do not come quite straight, if delay, before assistance has been sought, have permitted a certain hardening of the mus-

cles in the flexed position, a very slight pressure with the hand will secure a good posture, and then, while the child is still unconscious, one of the many modes of making extension can be applied. In other chapters I have spoken on this subject of position. I need only say here, that the good effects are more marked and more rapid at the hip than elsewhere; the alleviation of suffering and the exchange of acute symptoms for very mild phenomena are most striking.

The modes in which extension may be used are very numerous. The simplest is by weight attached to the limb below the knee. To make extension by a circular band is inadmissible, but we may use an ordinary roller thus: bandage from the foot to the tubercle of the tibia, pin the material to the last two turns of the roller on the outer side of the leg; bring it down below the foot and up the inner aspect of the limb to the same level opposite the other fixing; place pin again to make a half-turn, and bandage the limb downward sufficiently tightly; to the loop thus left under the foot any desirable weight may be suspended. Or resin plaster, running lengthwise of the leg and forming a loop under the foot, may be used. In either case pressure of the material against the malleoli is to be prevented by placing in the loop a slip of wood longer than the foot is broad. To this loop a cord is tied which may play over a roller or pulley hung at the foot of the bed. One pound for a child of about two years old is usually enough; four pounds at the age of sixteen is generally too much; but a great deal depends upon the frictionless working of the pulley. If any counter-extension be necessary to keep the child from being dragged down in the bed, a very low but long horse-hair or flock pillow, beneath the under sheet, may be placed against the nates.

A very considerable objection to reliance on this simple method is, that if there be tendency to lengthening, the child will sway the upper part of the body and pelvis to the diseased, if to shortening, to the sound side, thus producing abduction or adduction respectively, while yet the thigh lies straight in the bed. We may partly obviate this by placing on the upper sheet, that which covers the child, a sufficiently large sand-bag to run on the outer aspect of the diseased side, from malleolus to axilla; on the inner aspect from ankle to perineum; and next the trunk on the sound side, a bag reaching from hip to axilla; but even with all this the patient must be watched; small flexible bodies wriggle even out of these imprisonments. Or it may be better with unquiet patients to bandage the sound limb to a long Desault splint from foot to arm-pit, while extension on the unsound side is used. Bonnet, of Lyons, introduced a case of wire, fitting the back of trunk and both limbs, including the feet, from the loins downward. This he termed his "Grand Appareil," and Sayre of New York has adapted it under the name of "wire-breeches."[1] The appliance has not, so far as I know, been introduced into English surgery, and I personally have no acquaintance with it. I prefer, as a mode of making extension, a splint which I described (although I have slightly modified it) in my first edition. It consists of a long splint, with an interruption at the level of the hip, the whole being long enough to reach from the axilla to three or four inches below the sole of the foot; but the interruption is so arranged, that the portion which corresponds to the side of the trunk shall be on a plane a little farther inward than that which is applied to the limb. At the upper end is a pulley (*f*); at the lower, where the splint is forked, is a second (*c*), at the angle of divergence. From the prongs of the fork two

[1] He uses this chiefly after excision.

pieces of metal project, converging inward, and support between them a third pulley (*b*). In adapting this, we must first secure by resin plaster or bandage (see p. 311) a loop below the sole ; from this a cord—catgut is best—runs over pulleys *b* and *c*, up the outside of the splint. A softly-padded perinæal band, made of an ordinary woven bandage, which is tubular, stuffed with cotton-wool, encloses the upper part of thigh and splint, carrying a cord, which, coursing round the upper pulley *f*, passes down the outside of the splint. Between these two cords, which thus come near together, an india-rubber accumulator is stretched, which of course makes by its tension any desirable traction on the thigh downward. The advantages of this appliance are, that it can be applied on a limb which is already considerably flexed without bandaging, and if the tension be occasionally renewed the malposture will be gradually and painlessly reduced. Then the splint, omitting of course the cords, can be bandaged on from below upward,[1] and when the splint is fixed, the child may be moved from bed to couch, etc., without producing any movement of the limb, and while extension is being kept up. Moreover, while it remains *in situ* the child cannot sway the trunk to either side so as to produce either abduction or adduction. The American splints, long and short, greatly advocated by Dr. Lewis Sayre, have certain inconveniences, which, although I believe they

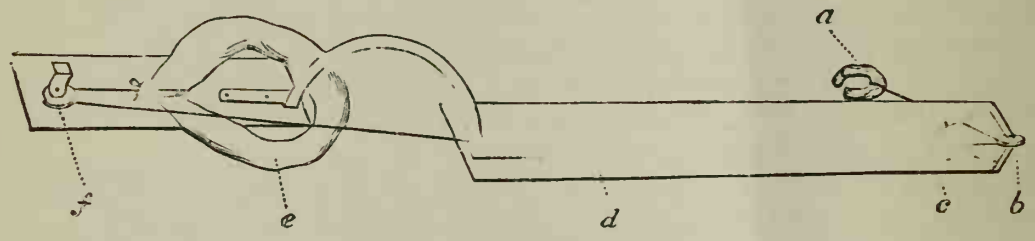

FIG. 63.

have been extensively tried, have prevented their general adoption in this country. The chief objection is that although we may get the plaster to adhere firmly enough to allow of efficient extension, yet the splint does not immobilize the hip. Yet, in certain cases, I have used the short splint with advantage, chiefly when a patient is, after treatment by rest, to get about.

Thomas's splint is certainly a valuable addition to our arsenal, although it does not do by any means all that has been claimed for it. It consists of a flat bar of soft iron, a quarter of an inch thick for grown persons, and half that strength for children, and from three-quarters to an inch wide ; this runs from the scapula to mid-calf of the diseased side—is bent to roughly fit the curve of the loin, buttock, and back of the limb. It bears three hoops, one for the chest, one for the upper part of the thigh, and one about mid-calf for the lower end. This is padded, supplied with shoulder-straps, and fastened upon the patient, being bent here and there so as to make the fit as near as such rude contrivance will allow. I have used this appliance pretty frequently, but in recumbency it is very apt to gall, even though a feather-bed be used ; and the management of the excreta is a serious drawback, since the upright behind thigh and buttock interferes with the management of the bed-pan.[2] Therefore, while the patient must re-

[1] For the trunk I am in the habit of using a broad belt provided with several buckles and straps.

[2] Mothers have pretty often told me, that in girls with this splint, micturition is a considerable trouble, soreness, even excoriations of the thigh, resulting ; cleanliness is hardly possible.

main in bed, my extension-splint, or the weight while the sound side is fixed in a Desault splint, is decidedly superior.

But to Thomas's method this praise is to be accorded, that by its additions, viz., high shoe on the sound side and crutches, we are enabled to get our patients about and to allow them exercise in the open air. I am very sceptical about anything like complete immobility being attained by this splint. Either from want of perfect fit, or by the power of escape from restraint that all children possess, the thigh certainly does, in a little time, get some range of movement—patients even become able to sit. I have cured children who, after the first symptoms have been subdued, were placed in this appliance. I have also cured patients by giving them a high shoe and crutches, withholding the splint, and am much inclined to attribute the chief advantage of the whole treatment to the former cause—that is, to absence of confinement in bed—to exercise and open air without throwing weight on the limb. The whole arrangement is less fitting for very young children.

So the patient, though he may not get well, as even under careful management is occasionally the case, may be guided painlessly or almost painlessly through the first, and the earlier part of the second stage—perhaps even farther. But, in some cases, about this time a rise of temperature, accompanied usually by pain, may be significant of approaching abscess. I fear that we shall never discover a means of preventing abscess—when once the inflammation has reached a certain point—but we may yet do a good deal to mitigate the pain and prevent the injury that pent-up pus will do. When at this stage and somewhat later the temperature has risen considerably and suddenly, the pain being at the same time severe and of abrupt commencement, it is the surgeon's duty to carefully examine the joint. For this purpose an anæsthetic should be given, the retentive appliance, whatever it may be, removed, and the joint examined first by mere palpation without movement. The points which are especially to be attended to are the amount of projection of the trochanter and its position in regard to Nélaton's line. If either of these be found abnormal, or if only the surgeon cannot be quite sure that they are perfectly normal, the thigh should be moved on the pelvis. This, during anæsthesia, is easy; but the direction must be definite, namely, first, simple extension with outward rotation, then, still the latter posture being preserved, the limb is to be slowly bent up and again as slowly replaced. No movements are to be carried to an extent likely to prove irritating; their intention is to prevent gradual dislocation (see p. 287) which the rapid increase of pain and temperature may indicate. I have four times in doing this felt a sharp sort of slap occur, and I have many more times found the recent symptoms added to an older coxitis subside after this treatment.

A slower rise of temperature and more gradual advent of pain indicate abscess, and this is, when those symptoms are pretty well marked, intra-articular; less decided phenomena, if they occur at all, indicate peri-articular suppuration. Now I am a decided advocate for opening any abscess, wherever it may be, whose presence and tension give rise to pain and pyrexia. An intra-articular abscess need not be given an outer exit; it is often enough to pass a tenotome behind the trochanter, glide it along to the joint, and turning the blade a little, divide the capsule lengthwise. The puncture must pass in close to the back of the trochanter and should not incise the parts very near its junction to the neck, lest a tolerably large branch of the circumflex artery, likely in this disease to be distended, be divided. If an abscess tend to the surface at any attainable part, it should be opened anti-

septically and pretty freely. Great mitigation of pain follows these procedures, and if the aseptic precautions be properly carried out, decline and not increase of fever results.

Patients do not often get as far as suppuration and recover without passing to the third stage, that of shortening; but it not unfrequently happens that if abscess commence at the end of lengthening, the disease begins to subside at the very commencement of shortening. It is therefore incumbent upon us to limit this malposture to as small an amount as possible, that is to say, to see that the angle of adduction and of flexion is to the utmost degree minimized. By this time the patient may have been invalided for two years or more: the surgeon and parents also are generally glad to compound with a recovery at any price. Again, there will be uncertainty as to whether any attempt at improving position may not again light up inflammation. Nevertheless there is no doubt that in most cases, giving evidence of recovery at this stage, a very slow but sure change of position may be effected, unless the child be in a Thomas's splint; the edges of whose iron upright being to right and left, render any wrenching in either direction quite impossible. If the weights and sand-bags, or weight with Desault's splint on the sound limb, be in use, the child may be turned on the mattress so as to present the diseased side toward the foot of the bed; the weight will then draw the limb a little more in abduction, and so by a minute change of position from time to time, one may gain a good deal. Or if he be in my extension splint, the iron connecting-hoop may now and again be wrenched, giving an eighth or quarter inch more outward bend. Flexion is often very difficult to restrain, but I have, on several occasions, gained a good deal by placing a firm, yet not too hard, cushion under the buttocks; only it must be frequently watched lest it glide upward to the loins. When inflammation has entirely subsided, and whether or not any abscess have formed, one of the most difficult questions to answer is the advisability or otherwise of passive movement, as a prophylactic of anchylosis. We have two questions to consider. Can we accomplish it? Can the patient bear it? Upon the answer to the former does in great measure the reply to the latter depend. The investigation of this point can hardly be carried out by endeavoring to hold the pelvis still while the thigh is moved—(we are supposing some mobility remains). Let the child sit on the bed, so that the nether limbs lie on the mattress, which must be a hard one. Keep the knee motionless and tell the child to lie down on his back; if flexion be present the pelvis will rise (p. 299). Now lift the knee from the bed until the loins lie flat, keep them down by pressure on the anterior iliac spines, and endeavor to straighten the limb. Or draw down the child so that the buttocks rest on the end of the couch, support the sound leg on a chair or stool, and let the other hang or project free. If there be no pain in the joint, while the limb is thus straightening itself, in the first method by weight of the body, in the second by its own weight, we may probably use passive motion as far as flexion is concerned. Let the child resting on the back draw the feet up (bending knee and hip) till the heels lie as near the buttocks as possible; then tell the child while the feet are restrained from sliding down in the bed to separate the knees. The sound one will follow the command readily enough—the other will lag behind. The surgeon takes them in hand, and with very gentle pressure separates them. If passive movement be as yet inadmissible, pain not merely about the adductor muscles, but in the joint at the back of the trochanter, will be complained of.

If it be determined to use movement, and I need scarcely point out how important it is to do so, unless it be absolutely dangerous, the method

must be adapted to the age of the child; it may sometimes be used as a game. The child, lying on the end of the bed or table, can have a weight strapped just above the knee and may be incited to see how often he can slowly raise it, detain it, and then rapidly let it fall; or with the buttocks on a board supported some way from the ground he lies balanced, and stretching his hands beyond his head tries to reach his toes. Abduction may be induced in the manner last described in the flexed position, or the two feet may be sundered while the limbs are straight. While erect the child may be incited to straddle sideways as far as he can, or, with arms akimbo, to throw up the foot to the side. One of these exercises should be gone through a certain number of times in the day, and besides the parts should be examined occasionally to see that progress is being made. Watchfulness must be exercised lest harm, *i.e.*, return of inflammation, result.

If, however, instead of recovering at the commencement of the third stage, the malady continue, with its fluctuating exacerbations mingled with periods of comparative ease, while abscesses about the thigh and haunch form and recede or burst, we can but guide the malady along its course, obviating malposition, alleviating pain, preventing, if we can, suppuration, or at least injurious accumulation of pus, taking patience to ourselves and inculcating it to the relatives. We are sometimes obliged in hospital practice to shorten the time of illness—from three to four years is a longer period than institutions are willing to give to a single case, there being very many other claimants for bounty; and doubtless some of the hips removed would in time anchylose or partially anchylose. Whether or no with a better limb than can be gained by excision, depends on the position maintained.[1] If considerable flexion and adduction be allowed or be unavoidable, the limb, when recovery takes place, will be horribly short. Much of our choice, therefore, whether to avoid or to recommend excision, will depend upon the posture we are able to maintain; but chiefly we are to be guided by the amount of suppuration, the number, size, and frequency of abscess, the symptoms of approaching or commencing lardaceous disease. These three circumstances, the condition generally, the amount of suppuration and probable destruction, the rectitude of limb which the patient can bear, are to furnish the foundation of our decision.

I have advisedly limited these last remarks to cases with frequent abscess about the thigh and haunch; the intra-pelvic abscess[2] stands in a different category; it indicates, as we have seen, acetabular disease. A small suppuration at this place, discharging itself behind the trochanter, may be left for a while, the exit being made sufficiently free; but a large and increasing abscess, especially if it point, whether with posterior outlet or no, below Poupart's ligament, inside the anterior inferior iliac spine, is an indication for excision which must not be neglected. A caries, and, what is quite as frequent, a necrosis at the floor of the acetabulum, cannot get well while the head of the femur is in its place. The position of the pus becomes dangerous to life, as it sometimes opens into the rectum or bladder. If not quite sure of the diagnosis, the bent probe may be passed into the post-trochanteric opening and diseased bone felt for, or the same may be done

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[1] I have under my charge at two Homes for Cripples (girls and boys) a number whose disease must have closely gone through these phases, and some who d ubtless were worse, who have recovered in the third stage with shortening, with marks of many abscesses, some with dislocation; but they are nearly all more lame than after successful excision. (See Chapter XX.)

[2] This word, of course, refers only to the bony pelvis.

after the anterior abscess has burst or been incised, and if the reverse side of the acetabulum be felt rough and hard, no hesitation should continue. If, even although all symptoms point to deep and widespread acetabular caries or necrosis, diseased bone cannot as yet be touched—and it is, owing to the curves of the surface, very difficult to get a probe-end to this part of the bone—it is our duty clearly to decide, and a finger passed into the rectum while the probe is in the wound frequently affords very valuable information. A large unremedied abscess in this place is generally sooner or later fatal.

CHAPTER XV.

SACRO-ILIAC DISEASE.

A FEW words must be said concerning sacro-iliac disease, since it is very liable to be mistaken for morbus coxarius.

It has been my lot to see and to treat a goodly number of these cases, sometimes in children, sometimes in young adults ; and from this experience I am not able entirely to agree with other writers on the subject.

The joint is an amphi-arthrosis, which, save in quite young children, and it is said in women shortly before parturition, possesses no trace of synovial membrane. The bones are united in the one portion by ligamentous fibres, among which fibro-cartilage is interspersed, and separated at the auricular part by two plates of somewhat rough cartilage, thicker on the sacrum than on the ilium, between which lies a yellow-colored material, closely resembling the central part of the intervertebral cartilage.

Diseases of this articulation are pathologically very simple, since they always originate in ostitis and caries, very nearly constantly, of the sacrum. Clinically, however, two forms of the disease require careful distinction, since the one is less amenable to treatment, and far more grave, than the other. The one of these is simply vertebral caries, precisely like that which gives rise to angular curvature, but occurring in the conjoined vertebræ which form the sacrum, instead of in the ununited bones of the spine, in the narrow sense of the word, and thence spreading into the joint. The other form commences on the lateral or articular facet of the sacrum or innominate bone, and, in my experience, nearly always of the former. I have seen but one case in which the innominate was primarily or principally affected.

The course of the former malady is extremely obscure, especially if it erode the bone pretty deeply, and have spread rather far in the upward or downward direction before encroaching on the joint. Indeed, I have known abscess to form and come to the surface before any manifest symptoms of sacro-iliac affection could be made out. The places where such abscesses point vary somewhat with the locality of the caries. If this be about the two lowest bones of the sacrum, the pus shows itself about, and rather behind, the anus. If the disease be higher, the resultant matter comes to the surface behind the great trochanter, being guided by the pyriform muscle. If an opening here do not give sufficient exit, the abscess may also point at the back of the anus, if the malady be low, or if high, it may show at the groin, in the locality of psoas abscess.

CASE LXIX.—Jane E., aged ten, was admitted under my care, April 12, 1878, with symptoms supposed to be attributable to hip disease. When I the next day examined her, I found behind the right trochanter an abscess which had not yet approached the skin. There was neither shortening nor lengthening of the limb, the movements of the hip were free and painless

while she was lying down, but she could only walk with considerable pain, bending much forward, and without support from a bystander's hands could not get along at all. She had great difficulty in ascribing the pain to any one place : it seemed in the lower part of the loins, in the right groin, and running down the inner side of the right thigh ; but this description was only obtained by cross-examination, and was, I think, doubtful. The pain, though severe, appeared very vague, and was absent while the patient was at rest. There was no pain on pressing the ilium either inward or outward, nor any about the sacro-iliac synchondrosis.

April 22d.—The patient was kept at perfect rest, the right limb placed on a soft pillow and confined by sheet and sand-bags. The only change in the symptoms was that the right limb was evidently, though only slightly, *shortened*,[1] and the abscess began to point. I preferred incising the abscess antiseptically to letting it burst into the unprotected air, and although the swelling looked small, I was surprised at the quantity (11½ ounces) of flocculent pus that flowed. A probe was passed into the opening ; it entered the pelvis by the sciatic notch, and touched bare bone ; my finger was then gently insinuated and was conducted to the front of the sacrum, where a soft pultaceous ulcer in the bone was felt. The abscess was kept open by a drain introduced only a little way. A certain improvement followed the evacuation of pus.

June 18th.—On examining the patient I found the limb an inch short. Movement of the hip was quite free ; but inward rotation, more particularly, produced some pain referred to the lower part of the loins. I caused her to flex up the leg and thigh so that the heel lay close to the buttock, and then to let the knee fall slowly outward. As soon as the limb became abducted the patient complained of severe pain. Pressure inward, on the ilia, but more especially outward, were very painful. It was now evident that the sacro-iliac amphi-arthrosis was affected. The patient was kept rigidly at rest ; but the suppuration was for five months excessive ; several small sequestra came away.

At the end of August the shortening was 1¼ inch. I again cautiously introduced a probe, and found, a little more than an inch from the sinus-mouth, long before the front of the sacrum could have been reached, a piece of soft, crumbly bone, which appeared loose. The opening was slightly enlarged, forceps introduced, and a flake of bone seized ; it would not come away entire, but was extracted in two pieces, which, fitted together as well as could be managed, were estimated to be in longest diameter 1⅛ inch, in shortest, ⅞ inch—it measured in the thickest part nearly ¼ inch. After this the suppuration increased and remained large for six days, then began to subside—gradually declined while the opening diminished.

February 26, 1879.—The child had lain at rest for ten months, but since the middle of December had greatly improved. At the above date there was still a sinus-mouth, the discharge from which was trivial. She was examined supported in the erect posture, and a great tendency to forward stoop, with projection at the top of the sacrum, was verified. The inner malleolus of the right limb lay not quite half an inch above the left. A plaster-of-Paris jacket was adopted, and when she was able to get about a little, she was dismissed with directions to come back from time to time ; these orders were, however, neglected.

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[1] Erichsen, Heath, and Lewis Sayre give lengthening as invariable in sacro-iliac disease—this is by no means constant. I have on record another instance, verified by post-mortem, in which shortening was a marked symptom.

Case LXX.—John B., aged sixteen, was brought to the hospital, July 10, 1865, in a very suffering condition, but it was very difficult to make out the source of his ailment, which appeared to date from the end of May, although he had been previously weak.

Every movement of the lower part of the body was painful; the left limb was $1\frac{3}{4}$ inch short; movement of the thigh caused him to cry out. He was very thin, but the lower part of the abdomen was tumid. Pressure all round the left hip and in the groin was so painful that no sufficient examination could be made.

July 16th.—Chloroform was given. The movements of left hip perfect; some deep fluctuation around, more especially behind the trochanter and below Poupart's ligament, with doubtful fluctuation, could be felt. On passing the finger per rectum, that intestine was found to be very lax, seemed surrounded by fluid, as far as search could be made; some very doubtful waves were suspected between the groin and the interior of the pelvis.

August 19th.—Signs of intra-pelvic abscess were rather more marked, but its cause was not apparent, neither was there any such tendency anywhere to the surface as to indicate a place for opening. Early in September, in my absence, pus broke forth behind the left great trochanter, but the discharge was slight and the opening small. Three weeks after an abscess about the anus showed itself.

October 3d.—I found an abscess discharging itself behind the left trochanter, and another, not open, extending nearly two-thirds round the anus. The left limb was œdematous, pain and difficulty on micturition and defecation was greatly complained of, the urine was alkaline and contained pus, there was irregular diarrhœa. The lad had evidently not long to live, but I thought it might relieve his bladder-pains to open the anal abscess, and to a certain extent relief followed the incision, which let out a large quantity of flocculent pus.

October 24th.—The lad died on the 22d. The *post-mortem examination* at the above date revealed a large pelvic abscess surrounding the rectum, and pressing forward opened by a small aperture into the bladder, above the left side of the prostate. On drawing the rectum to the right and detaching it from the parts behind, the whole left side of the sacrum in the neighborhood of the sacro-iliac joint was found deeply carious. The ulceration hardly encroached at all upon the ilium; it was very deep. The joint-surface had been so eroded that the finger introduced lay loose between the two bones. The posterior part and the ligaments were sound. The caries did not extend to the right margin of the sacrum, and the joint of that side was unaffected. The liver and the spleen were markedly lardaceous, the kidneys were large, purulent fluid was in the calices, but they were only very slightly lardaceous, the right one more so than the left.

These cases exhibit the worst form of sacro-iliac disease, the form analogous, as I have said, to vertebral caries. In the former the disease began in the front of the sacrum, in the latter the point of departure was uncertain; but the great destruction of the articular surfaces, and the early appearance of limb-shortening, would indicate this bone in the immediate neighborhood of the sacro-iliac joint as the place of commencement.

In contrast with these, I may, but more shortly, give the outcome of two cases, with many similar symptoms, sent to the hospital for supposed hip disease. The one was a boy, aged nine, the other a girl, aged eleven. In both, absence of hip-malady was quite clear, although in both the limb

was lengthened.[1] In both, pressing together of the ilia produced no pain, while pushing them outward caused some, but not severely, painful sensations. Now, the boy had a red fluctuating spot over the sacro-iliac junction, and in ten days after his admission this was opened; a fortnight later a probe passed through a rough osseous channel into the pelvis. I enlarged the skin-opening, applied a very small trephine head over the bony aperture, and cut out the carious part. I had just room to introduce my little finger, and found a piece of loose bone at the side of the sacrum, which, seized with a crooked pair of forceps, was extracted. It was rather larger than a horse-bean, and much of that shape. After this the abscess slowly contracted to a narrow sinus, the limb regained its proper length, and the child was sent to the sea-side. I saw him six months after, without morbid condition except the scar.

In the case of the girl, aged eleven, who was my patient ten months later, I hoped to gain an equal success. I cut down to the painful and suppurating spot, trephined, but found no loose bone. As much soft bone was about, I enlarged the hole with a gouge. She was placed on a ring-shaped india-rubber cushion, and the wound was kept well open. A free, but not excessive, discharge, mixed with bone-fragments, continued for seven weeks; then a piece of bone presented itself at the wound and was removed. It was a flake the size of a little finger-nail. After this the wound rapidly contracted, and, when it was a mere sinus, the girl was sent to a convalescent home.

Abundant evidence has now been given that the so-called sacro-iliac disease is composed of two forms of disease. The one is simply vertebral caries, affecting the front of the bodies of the vertebræ in that consolidated portion of the spinal column which is named the sacrum. It is a low Pott's disease. The other commences in the bones subtending the joint; and in my experience chiefly the lateral aspect of the sacrum, although I have seen one case in which the morbid action began in, and was almost confined to, the innominate bone. This form is always, or nearly always, at the back portion of the joint.

Symptoms.—From the narratives of cases above given, the semeiology of sacro-iliac disease might, without further word, be derived; but the chief object of the present chapter is to draw accurate lines of distinction between that malady and hip-joint disease. In reality but little difficulty in this diagnosis exists, if the surgeon will keep clearly in mind that the points of resemblance are: a certain limp, or even inability to put weight on the limb; flattening of the buttock, with perhaps pendulent nates; certain enlargement behind the trochanter, occasionally also in the groin; all or some of these being combined with either lengthening or shortening. The chief and most valuable points of difference are the mobility of the femur in the acetabulum, and the mode in which the ossa innominata move when the thigh motion is carried rather far. These are matters of minute observation, which I hope the ensuing description will render clear. While the patient stands, he bears all his weight on the sound limb, and will not (save in exceptional cases) move the other one at all, or only to a very slight extent. If told to flex the thigh on the body, *i.e.*, to lift his knee, he at once declares his inability. This mode of examination would impress one with the idea that the hip was the part affected. But if now the patient be placed supine on a couch, the surgeon, making the examination for hip disease, as described at p. 294, will find the joint mobile. He can move the thigh in

[1] I need hardly say that this lengthening is merely apparent.

every direction, but every movement is slightly restricted, *i.e.*, when the thigh is bent, straightened, everted, etc., *beyond a certain point*, the patient complains. This fairly free mobility at once negatives a diagnosis of hip disease. When the painful degree has been reached, and the thigh is made to exceed it by an inch or two, the pelvis moves with it, but not quite in the same way as in hip disease. An attentive eye will in the latter malady perceive that the pelvic movement is considerably greater on the diseased than on the sound side ; that is to say, the innominate bone of that side moves on the sacrum. In sacro-iliac disease there is none of this ; both innominates move equally, and in the same sense ; motion, therefore, of the pelvis is much more massive and large, while the lumbar spine, therefore, also all parts below the umbilicus, move with and in consonance with the thigh.

Next, tenderness of the joint must be sought for. This examination is best made by two persons. The assistant on the sound side presses his fingers backward, just inside the iliac spine, while the surgeon does the same on the diseased side. Each then draws the bone he has hold of outward. If pain be experienced, the patient should be turned on the face, and the neighborhood of the sacro-iliac joint on the side complained of examined. Pressure here, inside the posterior iliac spines, usually produces pain.

After these examinations, the various localities where swellings usually occur, or abscesses commonly point, should be thoroughly investigated—behind the trochanter, the iliac, and ischio-rectal fossa, as frequently also the rectum. If the examination be searching enough, there should be no ambiguity in the diagnosis.

To distinguish between the two sorts of sacro-iliac disease is scarcely more difficult. The one which commences in the joint itself is always accompanied by tumefaction and tenderness about the line of articulation, just inside the posterior iliac spines. The tumefaction is of indefinite and vague outline, but readily perceptible to the eye. The tenderness is easily called forth by deep pressure. In many cases, even early in the disease, the skin at this place is red. Thus, if we find symptoms of the disease in question, without the posterior swelling and tenderness, we may suspect caries of sacral vertebræ. This suspicion will be confirmed if there be swelling as of pus at a distance from the surface behind the great trochanter, and if pain be felt on rotating the thigh inward ; or if there be fulness and swelling at the crural arch, or behind and about the anus.[1] To these local appearances we may add that disease in front of the sacral vertebræ is combined, as a rule, with a more marked strumous cachexia, or in older persons with a more enfeebled condition than is disease of the joint proper.

Treatment.—Very early phases of sacro-iliac disease will occasionally be cured by mere rest and by such regimen or medicaments as suit the patient's age or the strumous constitution. The best means of securing the rest required is to put a long Desault splint on the sound limb, and attach a weight to the diseased one, not for the sake of extension, but merely to guard against involuntary movements. Or simply to lay sand-bags on the sheet which covers the patient. The one outside the limb should reach to the axilla, the one inside from near the perineum to the foot. But, in my opinion, the long splint should be applied to the sound limb, in whichever of these methods we treat the diseased one.[2]

[1] In this latter case tenderness of or roughness about the front of the sacrum should be sought from the rectum.

[2] I have used the same splint on the unsound side, but have found it, thus used, far less effectual in securing immobility.

Local applications are hardly admissible, since they can only be used by shifting the patient, and of course rubefacients or blisters would probably render the supine posture impossible. Hence, we are restricted almost entirely to the one remedy, *rest;* nor do I think any application from the actual cautery downward to sinapisms, is sufficiently certain in curative effects to warrant our placing the patient on a prone couch for the sake of using such remedies to the back; therefore, we must submit to very narrow resources.

But if the patient do not get well, if abscess form and point in one or the other direction, the condition becomes more grave, especially if the malady be of the first-named sort; if it be of the second description, if tenderness and abscess appear just inside the posterior iliac spines, we are not, in my opinion, justified in leaving the case quite alone, since great benefit will result from timely and judicious interference. When abscess at the spot above-named has been opened or has burst, a probe passed in will probably detect caries; the instrument may indeed impinge upon a sequestrum, or it may enter a narrow and rough channel in the junction of the bones and enter the pelvis. In the first case, if the caries be not far from the surface, it is the surgeon's duty to slightly enlarge the opening, and to gouge or with the osteotrite to clear away, the ulcerated part; if the second condition be present, mere removal of the sequestrum is a very efficacious and hopeful measure. Cases in these two categories, and thus treated, almost invariably do well.

If, on the other hand, the last condition prevail, further considerations are required, for the passage may be either a simple caries of the joint-surface or it may be a bony sinus leading to a deep and large ulceration in front of the sacrum. The diagnosis must be made by the mode of examination already described; if no sign of anterior sacral caries be found, the gouge and osteotrite may be used as above described. The surgeon will not of course overlook the position of the internal iliac artery, but I do not think it is endangered if moderate care be used, as the membrane forming the abscess-wall pushes the vessels forward. If sacral caries be verified, the disease is probably beyond the reach of art. The surgeon will consider if he will enlarge the bony sinus and procure a sufficiently wide drain to keep the interior of the pelvis free of pus. I certainly have thought, in one or two cases, that considerable advantage has followed this practice. Generally, when the disease lies in front of the sacrum, the abscess does not tend posteriorly, and further extension of disease, wider caries than necessary, may result from the mere presence of pus; hence the value of drainage through a posterior opening.

During the acute phases of the disease, supporting or constricting belts round the pelvis are injurious and improper; but when the activity has subsided, and has left behind a weakened joint with not too sensitive surfaces, these devices may be usefully employed, in part to limit movement or prevent strain upon as yet tender and feeble cicatrices, in part to give to the patient a feeling of confidence and security.

In either form of the disease the patient, when he recovers, should do so with neither limp nor lameness; but he who has suffered from anterior sacral caries will hardly, if he get well, escape a certain, often a considerable, forward stoop.

CHAPTER XVI.

ON AFFECTIONS OF SYNOVIAL SHEATHS AND BURSÆ IN THE NEIGHBORHOOD OF JOINTS.

The synovial membranes, which line tendons and their sheaths, which form fluid pads between the skin and bony points exposed to friction, or between tendons and the adjacent bone, in every case where the former passes over a tuberosity to be inserted at its further side, are all subject to inflammation.

Of the Bursæ.—These latter bags of synovial membrane are thus to be found in certain points of the body in a normal condition. Some are superficial, others deep. To the former class belong the sac between the skin and olecranon process, and that between the same structure and the patella, with its ligament, etc., etc.; to the latter, the bursa between the biceps tendon and tuberosity of the radius, between the ligamentum patellæ and tuberosity of the tibia, between the tendo Achillis and os calcis, etc., etc. But if, from deformity or other cause, any point be exposed to unusual friction, insufficient to produce ulceration of the skin, a bursa at that point will be formed. Thus, one will arise on the outside of the foot in talipes varus, if the person walk about; in angular curvature of the spine a bursa is developed between each projecting spinous process and the skin; and many other such instances might be given. The various facts and investigations upon this production of new bursæ show that they are formed from the common areolar tissue. They are, in fact, simply the shutting off of one or more areolar meshes as an isolated saccule or subdivided cavity, which, as fluids accumulate, expands. There is no structural difference between them and the bursæ normally found in the body; and therefore it may be well assumed that normal bursæ are also produced by the friction which they are developed to prevent. It is, however, necessary to remember that some of the deep bursæ, to be hereafter specified, communicate with the neighboring joint. This fact causes a certain difference in the prognosis and treatment of disease in those particular sacs.

The inner lining of these sacs is not smooth, but covered by fringes like, but smaller than, those in joints; moreover, fibrous bands, running along the wall, project into the cavity. The outer coat is simply condensed areolar tissue, and is continuous with that structure on all sides. If the bursa be subject to considerable pressure, its outer portions will become more condensed, till they assume a fascia-like appearance and hardness.

Any bursa of the body is liable to become inflamed, and the attack may be either acute or chronic; even the acute disease may be simply one which causes increase of normal secretion and thickening, or it may be suppurative. Fortunately, suppuration of a synovial bursa does not often arise spontaneously, except in subcutaneous sacs. I have never been able clearly to ascertain such action in any deep bursa, although in certain cases of deep-seated diffuse suppuration I have considered a synovial sac the prob-

able birthplace of the disease. The purulent inflammation is usually produced by a blow, or some external violence, acting upon a debilitated constitution. The action is not confined to the bursa itself, but is of a diffuse form, and attacks the areolar tissue continuous with the bursal walls. The general symptoms are precisely those of the "diffuse inflammation of the cellular tissue"—of what used to be called "phlegmonous inflammation," viz., a brown, dry tongue, heat of skin, sleeplessness, and a weak, quick pulse. The local symptoms differ only in this, that in the phlegmonous inflammation the pus can only be diffused into the areolar meshes; in bursal suppuration a cavity pre-exists, wherein a good deal of the pus is always collected, and thus we have the local symptoms of a circumscribed abscess combined with those of a diffused one. The skin at the inflamed part is of a dusky red; the color has no sharp boundary, but fades gradually into the normal hue of the surrounding skin. The swelling is more or less conspicuous, according to the size of the bursa, its superficial position, and the stage of the inflammation. The heat is very considerable, and the pain is great as long as tumefaction continues and tension be not relieved. If the case be suffered to go on, as sometimes happens, without any adequate treatment, typhoid symptoms develop themselves, and the state of the patient may become critical; absorbent inflammation, greater and greater debility, ultimately prostration, with low, muttering delirium, will shortly be followed by death from exhaustion or purulent infection.

The general treatment should be stimulant and tonic. Bark and ammonia, quinine with ether, chlorate of potash, or other such medicine, combined with opium and camphor, or opium and chloric ether at night; wine, brandy, or, in those accustomed to it, gin, may all, in the worst cases, be needed. It is generally advisable to give, before resorting to any of the above means, a brisk purge; but this is certainly not always desirable. Our power over the intestinal mucous membranes is often very much abused, and in few ways more than in first attacking all patients with a drench.

Free incisions through the whole reddened portion of the skin, profound enough to include the deep side of the bursa, compresses and injections of carbolic acid or chlorinated soda, is the fit local management. When the patient recovers from the depressed condition, the wound made into the skin and the walls of the abscess begins to granulate and to throw off any sloughs that may have formed. Among these must be included the whole bursa. It comes away in white soaked shreds of dead material, not one portion retaining any life and remaining behind. The separation of the dead tissue may be hastened by the use of linseed poultices made up with chlorinated soda; sometimes, when the slough extends very deep and the sequestration is sluggish, it is well to cut away with knife or scissors pieces partially separated, lest in their putrescence they infect the system. After a time, even before all the sloughs have separated, the poultices may, if the skin and wound look sodden and inactive, be changed for a dressing of dilute carbolic acid; and when the sloughs have entirely come away, lint dipped in cold water; or, if the granulations be flabby and the discharge considerable, a solution of alum (from ten to twenty grains in the ounce) may be advantageously employed. As the bursa, particularly when swollen, occupied considerable space beneath the skin, a cavity will be left, in which pus will collect, unless its sides be kept together. It is therefore necessary to apply some pressure by means of pads, with a bandage or strapping plaster.

Subacute, or chronic and non-suppurative inflammation, may attack either a superficial or a deep bursa, and though the disease may not lead

to such violent symptoms as the pus-producing malady, it causes frequently considerable pain and inconvenience. When the bursa thus affected is superficial, the nature of the disease is easily discovered, and its treatment, if the attack be recent, by blisters or iodine, or other form of counter-irritant, is obvious, but frequently fails. A very common example is an inflammation with enlargement, through effusion of synovia into, afterward through thickening of, the bursa between the skin and patella. The disease is brought on by the necessity which women, employed in housework, labor under of kneeling a great deal, and of moving about on the knee; when the bursa becomes thus affected the pain of such occupation is very considerable. Recent cases, in which the walls of the sac are not yet much thickened, may be advantageously treated by blisters or other counter-irritant. I have frequently cured such tumors by passing a long-bladed tenotomy-knife for some distance through the skin, and dividing the bursa as widely as possible subcutaneously. Injections with iodine may also be employed. If the irritation through much kneeling continue, the walls of the bursa are very apt to thicken by concentric formation of fibro-cartilage, so that at last a tumor, either quite solid or possessing only a small central cavity, filled with the synovia-like secretion inspissated to the condition of atolerably firm jelly, forms. On section, these growths generally show a number of cartilaginous or fibro-cartilaginous laminæ. Their diagnosis is very obvious. The resilient solidity of the tumor, its somewhat slight mobility over the patella and its ligament, its situation, and the normal condition of the knee-joint, all mark the disease in a manner quite unmistakable.

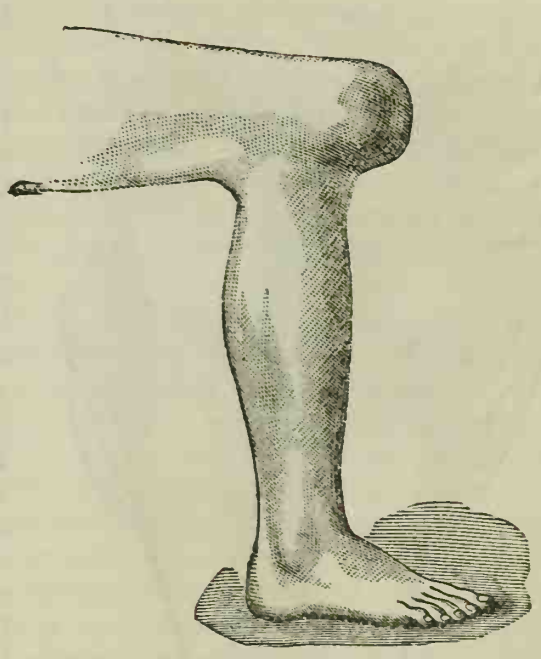

Fig. 64.—Enlarged bursa patellæ.

A large, solid bursa of this description confers often a most grotesque appearance when the knee is bent at a right angle. The subjoined plate (Fig. 64), from a photograph, shows this very well. The tumor continuing, the line of the thigh causes it to look like a conical amputation stump; the leg appended to it appears an addition, as a thing which has nothing to do with the rest. I also give a representation of the same disease in another patient, who had such tumors on both knees, in order to show the appearance while the limbs are straight (Fig. 65).

It need hardly be said that no remedy save excision is of any avail. All danger from suppuration may be avoided by performing the operation antiseptically. As the skin has been greatly stretched by the growth, a longitudinal gore, or oval-shaped piece, should be removed. At each side of the ligamentum patellæ the synovial membrane lies close beneath the tumor, and the surgeon must take care not to open it. As the wound lies so near this structure, a proper precaution after operation is to place the limb on a splint; but I have never seen, in my own practice, a synovitis follow excision. Both the cases above depicted underwent this operation. The one with double housemaid's knee, still in the prime of life, was well

on the eleventh day ; in the other case, an old woman, the wound, healthy but sluggish, did not heal till the sixteenth day.

Of more surgical importance are affections of the deep bursæ, because they are sometimes apt to perplex the practitioner, who is not much in the habit of examining joint diseases. A large bursa situated under the deltoid muscle is not unfrequently the seat of a painful affection. It usually is produced by chill or some slight accident—a strain or fall on the shoulder ; I have seen it combined with fracture of the clavicle. The inflammation may be subacute, or very slow and chronic, and in either case may somewhat simulate a synovitis of the shoulder-joint. The distinction is to be found in the greater protuberance of the deltoid muscle, without swelling over the head of the bone in front, and the perfect maintenance of the humero-pectoral groove. Passive movements of the limb, and the active movements as long as the arm hangs down, are all but painless ; but, as soon as the patient endeavors actively to abduct the arm, the pain is excruciating. Passive abduction, on the contrary, relieves the pain. The bursa, thus inflamed, nearly always crepitates upon pressure. It is to be observed that this sac is said to communicate sometimes with the shoulder-joint. Such condition must be extremely rare, but still the surgeon should remember that it may exist. On the other hand, a large bursa, which lies between the neck of the glenoid process and the subscapular muscle is, as a general rule, in communication with the shoulder-joint, but, so far as I know, gives rise to no surgical disease.

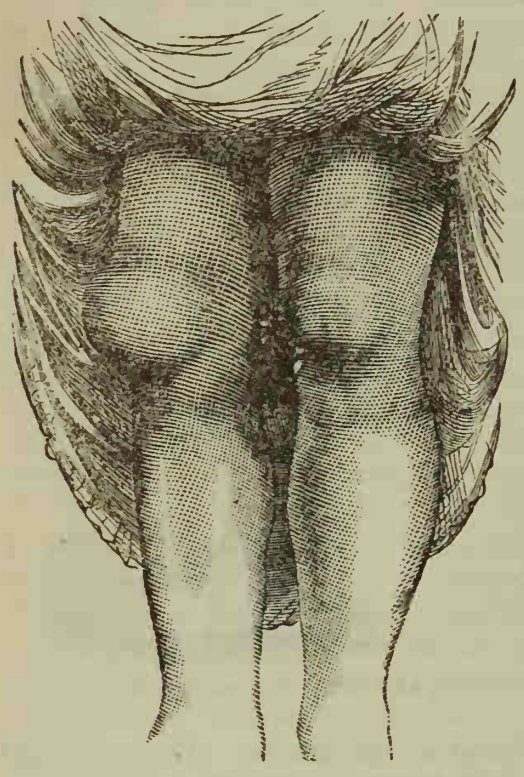

FIG. 65.—Housemaid's knee (double).

Neither the bursa at the olecranon nor that beneath the biceps tendon is likely to lead to any complication: its inflammation can hardly simulate synovitis. Between the triceps and the humerus there lies a sac which sometimes is an independent bursa, but more often a prolongation of the synovial membrane of the elbow-joint. This may become inflamed, and as the exact relation with the joint of the part is in every case doubtful, it behooves the surgeon to know with what he has to deal. If this sac be an independent bursa, inflamed for and by itself, the joint remaining normal, there will be no swelling or puffiness between the inner condyle and olecranon process when the arm is bent at right angles ; but the infallible test is that the line of junction between the head of the radius and the humerus is as clear and well defined as ever. If, on the other hand, the inflamed structure communicate with the joint, then these parts will participate in the general puffiness and swelling. There are several small bursæ about the wrist, but we will postpone their consideration.

About the thigh are situated deep bursæ whose inflammation may distantly simulate joint disease. That one which is placed beneath the psoas and iliacus tendon occasionally becomes thus inflamed, and produces very

considerable pain at the top and inside of the thigh in front of the origin of the gracilis muscle; it may even become sufficiently enlarged to cause in a thin person visible enlargement at the groin. This sac frequently communicates with the synovial membrane of the hip-joint, and then that entire structure will join in an inflammation which may have begun only in the prolongation; the symptoms of hip-joint synovitis will then of course be found. When, however, the bursa is separate, the pain and tenderness will be limited to the upper and inner part of the thigh and the groin; there will be no pain, no tenderness, and no swelling behind the trochanter. This sac generally owes its inflammation to some accident—a fall or a slip throwing the leg outward—and if this occurred in an aged person it may at first lead to the supposition that the neck of the thigh-bone has been broken; it is well known how difficult it is to detect an impacted fracture of this bone; it is therefore wise not to attribute this pain at the origin of the adductors (which is also present in that form of fracture) to the slighter malady, until the absence of a graver injury be entirely ascertained. The great pain produced by an inflammatory affection of the psoas bursa may be set at rest by flexing the thigh on the body, and rotating it somewhat outward; the patient should be kept in this posture for some days, and a counter-irritant be used. Blisters are in this spot hardly applicable, and in delicate-skinned persons I have known even the tincture of iodine produce a too violent effect and intense pain. I have used with advantage the nitrate of silver lotion (Formula XXXI.), which does not blister and crack the skin like iodine. If the patient be seen immediately after the injury, a hot hip-bath will afford great relief.

The large sac, situated beneath the tendon of the triceps and crureus muscle above the patella, is a prolongation from the synovial membrane of the knee-joint; this structure, as is well known, rises up on the femur in some persons much higher than in others, and when the cavity becomes distended with fluid, as in hydarthrosis, it reaches farther than under ordinary circumstances. Occasionally, even when there seems a separate bursa above this prolongation, the partition between them will be found incomplete; in a few instances the bursa is really separate. The diagnosis between inflammation of the synovial membrane and of the sac, when distinct, is easy, particularly while the patient is in the erect posture; swelling and fluctuation on both sides of the ligamentum patellæ mark the former disease; limitation of these symptoms to a space above the patella, and perfect contact of that bone with the femur, the latter.

I have already pointed out that in hydarthrosis this sac is often more distended than the rest of the joint. Of the two bursæ, situated the one over, the other under the ligamentum patellæ, mention has been made, and inflammation of the former has been described; the same disease occasionally attacks the deeper sac. This condition is most common in rapidly growing boys about the age of puberty, and I have in two instances known it to be mistaken for commencing ostitis of the head of the tibia. It produces a dull pain, aggravated by exercise and a certain swelling of the part, which looks as though the tuberosity of the tibia were abnormally developed. Limitation of the pain and tenderness to a small spot just above the greatest protuberance of the bony process beneath the tendon; the fact that pain is only present during or immediately after exercise, and absence of night pain, are sufficient to mark the nature of the disease; it often lasts for two or three years, and prevents the lad taking much exercise.

Children between the ages of six and fifteen frequently suffer from a dull aching pain at the back of the heel, increased by exercise; grown

people may also experience the same inconvenience—chiefly after having worn a boot which presses on the part. It arises from inflammation of a bursa situated between the tendo Achillis and the upper part of the tuberosity of the os calcis. The malady is only of importance as a disease to be distinguished from ostitis.

Tendinous Sheaths.—Many of the tendons, chiefly those of the hand and foot, are surrounded by so-called sheaths, consisting internally of a fine synovial bag, folded round the structure, and generally protected by a dense fibrous membrane: certain tendons are isolated, each in a separate sheath, others are grouped together, one sheath sufficing for the whole number. The synovial investment usually projects beyond the fibrous protection, chiefly at the distal end. The structure of the synovial tissue is similar to that of the joints—it is very fine, and the fringes on its inner surface are less developed than in articulations, but spread over a larger portion of the surface.

These synovial sacs are liable to inflammation, which is not unfrequently suppurative; the disease gives rise to very acute pain and to swelling in the part, and if it be allowed to continue without relief it causes in the surrounding structures an inflammation, generally phlegmonous, with great tendency to run along the absorbents; such a malady frequently occurs in the hand and fingers, and requires, as is well known, free incision and support to the general system. A similar condition sometimes arises in the palm of the hand, and those extremely painful suppurations beneath the plantar fascia generally originate, I believe, in a tendinous sheath. When the large synovial structure in the palm suppurates there is usually a great deal of constitutional disturbance with considerable pain, and the inflammation is very apt to spread up the arm. If this condition continue sufficiently long unreduced, the tendons may slough; as in any other sheath, suppuration is apt to cause death of its contents, it is therefore necessary, in acute cases, to incise the swelling along the whole length of the palm; even this is not always enough, for, although the bag is only one, it forms, by its reduplications, three sacs—one between the superficial tendons and annular ligament, another between the superficial and deep tendons, a third between this latter set and the anterior carpal ligament. The sac stretches from the palm, extending lowest along the tendon of the little finger, to above the annular ligament; so that when it is filled with fluid the swelling is in both the palm of the hand and the wrist, there being between its two portions a division or constriction formed by the above-named ligament. When the suppuration is very acute it is necessary to open the sheath from the situation of the superficial palmar arch upward, cutting fearlessly and deeply through fascia sheath, annular ligament, and even letting the knife pass among the flexor tendons; by such means only can we save the part. Sometimes, however, the suppuration is not so violent but that it will admit of a less heroic treatment.

Case LXXI.—Mrs. G. had sprained her hand very severely by overexertion, and three weeks afterward, having continually got worse, she came to me at the Charing Cross Hospital. The palm of the hand was much swollen and red, also at the wrist was a red, puffy, fluctuating tumor; she was suffering considerable pain; the fingers were semiflexed; movement, particularly of the three inner fingers, was exceedingly painful, that of the index less so; the thumb could be moved with but little inconvenience. The appearance of the hand was peculiar, swollen at the palm and wrist, while between these parts the tumor was deeply bisected; it at once

suggested fluid in the flexor sheath; the fingers of one hand placed on the carpal swelling, those of the other on the palmar, detected fluctuation between the two; and when the latter alone was pressed, the former visibly enlarged. The constitutional disturbance was not great, but was sufficient, combined with the redness at the wrist, to lead to the conclusion that the fluid in the sheath was pus. I incised the carpal swelling from the edge of the annular ligament upward; made a large, hard pad of tow, and bound it with great force in the hand; placed the arm on a splint, with the wrist bent backward, so as to obtain as much pressure as possible from the flexor tendons on the deep reflexions of the sheath. Three days afterward I saw her again; the discharge had been at first profuse, but was now diminished; she complained a little of the position and pressure. The palmar swelling had nearly disappeared. In a week I was able to use a smaller pad; and in a fortnight the discharge had ceased, and the wound was beginning to heal. I continued the pad and splint for three weeks, after which a bandage, with simply a few folds of lint in the palm, was substituted, and in a month the hand was restored, stiffness from confinement only remaining. During the first part of the treatment she took quinine and stimulants; afterward the latter remedies were discontinued.

Now, although it would be a grievous error to neglect to make deep and long incisions through the palmar fascia and ligament, when such treatment is necessary, yet would it also be mistaken surgery to cut into the palm if the disease could be otherwise treated; for when the palmar fascia has been wounded it contracts on healing, thereby tending to drag on one or more of its attachments to the phalanges, and to bend permanently some of the fingers. The judgment of the surgeon must be founded on the amount of swelling and of tension, the rapidity with which the pus has formed, the tendency of the inflammation to run up the arm, the temperature and the amount of constitutional disturbance. In rapid cases, and those in which the system sympathizes materially, the palm must certainly be opened, particularly if there be the least sign of absorbent inflammation: in slower cases an incision above the annular ligament, with considerable pressure in the palm, will suffice.

A sprain includes all injuries produced by forced displacement of an articulation short of dislocation; and, indeed, a partial dislocation may have actually been present while the force acted, replacement occurring as soon as it ceased. Such an extreme case of sprain is usually, if not always, accompanied by more or less rupture of ligaments, even of tendons, and is succeeded by acute synovitis. A milder application of force may rupture a few fibres of one or more ligaments, tear the areolar tissue and some of its small vessels, besides causing bruise of the tendinous sheaths; a still less powerful injury may only produce the last effect. A sheath is most liable to be bruised when the tendon which it contains is bent at an angle, so that the muscle acting powerfully forces the curve of that structure against the delicate synovial sheath. This is very much the case in the foot, where most tendons, both anterior and posterior, are thus bent; also at the hand, when the wrist being forced backward the extensor muscles would draw the tendons into a straight line, were they not confined by the sheaths; the force necessary to resist this tendency produces the bruising. This is, of course, followed by inflammation. A good knowledge of anatomy, and of the actions of muscles, will lead to an accurate diagnosis, if the surgeon will take the pains to observe that those positions, which put the injured tendon on the stretch, are painful; those which relax it, pain-

less. In all cases the painful active movements will be the opposite to the painful passive ones. To diagnose the condition of the ligament it is necessary to produce a passive movement that shall render that structure tense without implicating the neighboring tendons. An example will show at once what is meant. Let us suppose a sprain, with pain and swelling behind and beneath the internal malleolus. If the tendons of the tibialis posticus and flexor digitorum muscles be sprained, passive extension of the foot is very painful, while passive flexion is comparatively painless. Active movements are contrary; the patient can scarcely point the foot and toes downward from extreme pain, but can raise it upward with relative ease. If the surgeon, keeping the foot at right angles to the tibia, endeavor to turn the sole outward, he puts the internal lateral ligament on the stretch without influencing the tendons, and the presence or absence of pain during such operation will enable him to judge of the condition of that structure. The same mode of diagnosis, adapting the movements and positions to the particular joint in question, will always reveal the nature of the accident. It must be remembered, however, that all bad sprains are compounded of tendinous, ligamentous, and often joint injury. Sometimes, also, a dislocation of a tendon from its groove takes place, an example of which is given at p. 368.

It is much easier, there can be no doubt, to recover perfectly from a simple fracture than from a bad sprain, which implicates the ligaments; but the tendinous, or rather the sheath injury, of which we are now speaking, is not generally difficult to cure. We have to do with a thin synovial membrane lying generally near the surface. If the sprain be seen early enough, a local bath of hot water, kept for an hour at as high a temperature as can be borne without actual pain, will greatly relieve, if not altogether cure, this form of complaint. Subsequent rest, with counter-irritants, or pressure, or both, will remove whatever inflammatory condition may still linger, if, at the same time, rest of the part be strictly enjoined. The great cause why a sprain, of the ankle for instance, often lasts so long is, that the sufferer walks about before the inflammation has been subdued, and so keeps up the morbid action, while a few days' more rest would suffice for the cure. Another cause of the long continuance of the inflammation is, I believe, a faulty choice of counter-irritants. When it is desired to affect, by such means, a part far from the surface, a slow, deep-biting application is desirable; when, however, the inflamed texture lies close to the skin, such a counter-irritant adds to, instead of drawing from, the original evil; and I am sure that I have seen iodine reproduce inflammation of, and effusion into, superficial tendinous sheaths. A much better application is a mild and oft-repeated sinapism, a flying blister, the nitrate of silver lotion, which affect little more than the surface. When the inflammation has subsided, and all that is wanted to complete the cure is, that the sheath should regain its natural size and form, pressure is a most valuable means; whether this be effected by the bandage or by strapping, it should be recollected that the natural hollows of the part must be filled out by pads. If, for instance, the ankle be strapped and the hollows beneath and behind the malleoli be not thus padded, the application will surely do more harm than good, particularly if the ligaments or tendons there situated be implicated.

The mildest form of a recent, and more or less acute, inflammation of the synovial sheaths is that which Velpeau first described as painful crepitation (*crépitation douloureuse*) of the tendons. It appears to arise from the application of too much force, not violently, as sprains are caused, but from a slow and gradual exertion of only a slight superabundance of

power: thus, washerwomen are very subject to this complaint after a hard day's work wringing out linen; young ladies, after practising several hours at the piano, also are apt to contract the affection. It is altogether more common among women than men. It appears to consist of an inflammatory condition of the sheaths of the tendons, whereby their villi are exaggerated and their inner surface roughened. It hardly occurs except in the extensor tendons of the fingers, sometimes in those of the toes.

The symptoms are—an indefinite pain, on any movement of the parts governed by the affected tendons, and, in the worst cases, even when these are still; it sometimes continues during sleep, so that the person, being aware of uneasiness, dreams and enjoys no sound slumber. There is very seldom any redness over the part. If the surgeon hold the limb in his hand and make the patient bend or flex the fingers or toes, as the case may be, he will feel a peculiar cracking beneath the skin—hardly a crepitus—a sort of rustling in the line of the tendons. The treatment is rest and slight counter-irritation, as by camphor liniment, the application for five or six minutes of a mustard poultice, and so on; but, in truth, the crepitation and pain will cease, if rest be allowed, without further interference, and I have sometimes questioned the benefit of any stimulant application.

Sprains, if not perfectly cured, may result in permanent enlargement and dropsy of the injured sheath, and such disease may also follow the painful crepitation of tendons; it also may arise independently of any known injury, or of any acute or painful inflammation. It consists simply in the gradual distention of the sheath, by fluid of a synovial character, until it presents a fluctuating tumor under the skin. Of course, such distention can only take place where the synovial membrane is not bound down by a fibrous sheath, hence those sacs which are thus confined protrude only at either, generally the distal, end of their tough investment. The most usual situations for these fluid tumors are the back and palm of the hand, and the back of the foot. The synovial sacs in these situations invest, as already has been said, one or more tendons; and hence the swelling may either be fusiform, if the tendon be single; bifurcated, if double; trifurcated, if triple, and so on. Those which appear on the back of the hand at its inner side are single toward the wrist and bifurcated or trifurcated toward the fingers; those which arise over the index tendon are single, *i.e.*, fusiform at either end; they are usually lobulated, being in some places bound down by stronger bands of the fascia than in others. The same appearances are found when the tendons of the extensor brevis digitorum pedis are affected. In both these situations, as the tumor is very superficial, so is it diaphanous. When dropsy affects the large sheath, enveloping the flexor tendons of the fingers, the swelling has the same bisaculated form as was described when speaking of suppuration in that sac: it presents a large tumor, part of which is in the palm, part in the wrist; it is bisected by the annular ligament at the base of and between the thenar and hypothenar eminences. The tumor may be diaphanous in the wrist, but is not so in the palm. The same remarks apply to the disease when it affects the long flexor tendon of the thumb; a case of this is given at p. 333.

Very often these sheath-dropsies are multilocular, being divided into a number of cavities by membranous partitions; moreover they frequently contain a variable number of little, translucent bodies, ordinarily about the size of mustard-seed, or apple-pips, floating loosely in the fluid. It is remarkable that these peculiarities of division into many cavities and of corpuscular contents are much more common in sheaths of flexor than of ex-

tensor tendons. No adequate reason can be given for this predilection ; we must therefore be content with simply noting the fact. Dupuytren considered the loose bodies to give in some way a lobulated form to the sac, which is in reality, however, due, as already said, to the disposition of the fasciæ which cover them ; he also considered them to be hydatids ; hence, tumors containing such melon-seeds were named tumeurs hydatiformes and tumeurs en bisac. The account which Sir E. Home gave of Hunter's view concerning the formation of these bodies [1] may be in some rare instances correct, but there is now very little room to doubt that they nearly always originate in a hypertrophied condition of the synovial fringes in the same way as the false bodies are produced in joints. (See p. 181.) The growths in a recent state are oval in form, and in tendinous sheaths rarely larger, generally smaller than apple-pips ; transparent or diaphanous and colorless, or of an opal-gray ; put into spirits they become opaque and yellow. Examined by the microscope they are seen to consist of simple fibres ramifying in a jelly, among which an occasional cell, or nucleus, may be observed. Their presence, unless in very small quantities, may be judged from a particular sensation, which they communicate to the hand of a surgeon examining the fluctuation of the tumor, namely, a sensation of minute parchment-like crepitation, different to any other crepitation, to that of bone or to that of fluid crackling often present in enlarged bursæ. It is important to become acquainted with this feeling, because the absence or presence of these bodies influences both the treatment and prognosis of the case.

A dropsical sheath of the extensor tendons does not usually contain any melon-seed bodies, and therefore is more easily managed than a like state of the flexors, in which such formations are generally present ; often mere counter-irritation, combined with pressure, will in time disperse the former swellings ; but such treatment is not invariably successful ; it always occupies considerable time, and it is occasionally important to get rid of so ugly and inconvenient a tumor, trifle though it may be, as soon as possible. A subcutaneous section will evacuate the fluid ; it should be made by passing a long tenotomy-knife through the skin, at a distance from the sheath, piercing the dropsical bag, and dividing it to a considerable extent, carrying the cutting edge of the tenotome under the skin and parallel to its surface, so as not to wound either it or the deeper parts. It often happens, that even when the sac has been thus freely divided it will fill again, but counter-irritation hardly ever fails to remove the newly effused fluid pretty quickly, however intractable may have been that first effused. Injection with iodine may be resorted to if desirable, and it never happens that a dropsy void of melon-seed bodies refuses to yield to such a measure, combined with counter-irritation and pressure.

The distended sacs containing melon-seed bodies cannot get well under mere counter-irritant treatment.[2] Incision of the sac, as above described, is therefore necessary ; but it is not always possible to cause evacuation of all these little concretions, and those left behind keep up sufficient irritation to determine the return of the dropsy. When the disease occurs in the large sheath of the flexors of the fingers, it is very difficult of cure. Pro-

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[1] Transactions of a Society for the Improvement of Medical and Chirurgical Knowledge, vol. i. John Hunter conceived them to originate in clots of blood effused on the surface of the membrane, which adhered and became organized, and then were gradually separated by friction, leaving behind them a filamentous attachment to the bursal walls.

[2] Observe the likeness of this disease to hydarthrosis with change of structure.

fessor Syme has published the account of such a case,[1] in which he laid open the palm and wrist from end to end, cutting through the palmar fascia and the annular ligament, and took out all the melon-seeds he could find; but the anatomy of the part shows that, even so, he could not get at the whole cavity of the sac, except by turning the superficial and then the deep tendons out of the carpal groove. I have treated such cases less heroically with success; and although I should not venture to say that such an incision was never necessary, yet it certainly need rarely be resorted to.[2]

We have, however, at the present day, a resource which enables us to make these incisions without the dangers that attended them in bygone days. Under the antiseptic spray, and with that form of dressing, we may without any danger cut into these tumors, and I have, since adopting this method, often laid open the palmar sheath without fear and without any ill consequence. My late colleague, Mr. Canton, incised the largest thecal dropsy I have ever seen. It affected the long flexor of the thumb, and was peculiar in its anatomy: commencing at the second joint, it formed a large lump on the first phalanx and on the thenar eminence, becoming very much smaller under the carpal ligament. Above that place, instead of running up the radius, it passed obliquely across the front of the arm and round the inner margin to the back of the ulna. When this was opened, about a pint and a half of melon-seed bodies, with just enough synovia to afford them mobility, was evacuated. Not one of these bodies was as big as a rape-seed; but rather larger than whole mustard. Perhaps one has no very clear idea concerning the look of a million objects, but considering the size of the separate bodies, and the bulk in the aggregate, I should compute their number at between two and three millions. The woman, a laundress, forty-seven years old, made an excellent recovery.

Ganglia have been much more the subject of minute inquiry in France than in England, where, if we are to judge from the descriptions given in most surgical works, the utmost discrepancy as to their anatomy and pathology prevails.

Thus Chelius (South's translation, p. 629) describes them as "round, of slow growth, rarely exceeding the size of a pigeon's egg, and in general consisting of thick-walled cavities developed in the neighborhood of joints and sheaths." Miller, p. 546, says, "the cyst is thin and transparent." Cooper ("Dictionary," art. "Ganglion") speaks of "an encysted, circumscribed swelling;" while Syme, "Medico-Chirurgical Transactions," describes under that name, one of those non-encysted tumors, which occasionally occur in the palm of the hand and wrist. Again, Chelius especially mentions "little, white cartilaginous bodies," as a constant part of their contents, while most do not mention such bodies at all.

Where such wide discrepancies in the description of the broad general characteristics of a disease exist, it is certain that the writers are treating of different maladies under one name. The term "ganglion" has acquired a popular sense, and has been applied so broadly, that it has lost the precision of meaning which alone stamps value on a scientific term.

It is necessary, at the very commencement, to deny what many have stated—that such tumors are usually new formations, produced by the establishment, through friction, of a bursa, which gradually increases until it becomes a tumor. It is well known that friction upon the skin will pro-

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[1] Contributions to the Pathology and Practice of Surgery, p. 212.

[2] See my paper On Synovial Tumors in the Neighborhood of Joints, Lancet, October 9, 1858.

duce bursæ; but not without thickening of the skin itself, and it is just at the back of the wrist, where these tumors are most frequent, that the skin is thinner than in any other part of the hand. Moreover, there exist normally from fifteen to twenty small bursæ about the hand, but not one of these is at the back of the wrist; they are placed chiefly over the prominent heads of bones, in situations where I do not remember ever to have observed a true ganglion, or to have seen one described. The fact is, that the membrane, which forms the wall of these tumors, is borrowed from some normal synovial sac in the neighborhood, and it is on account of the great abundance of such tissue about the carpus and tarsus—viz., in sheaths of tendons and multitudinous joints, that such swellings are peculiarly common in these situations. Cruveilhier was perfectly aware of this fact, for he says, in the third volume of his "Anatomie pathologique" (p. 455), "I shall divide synovial cysts into two categories—*a*, into periarticular; *b*, into peritendinous cysts." Reinhard, a German writer of high eminence and remarkable precision, observes, in the art. "Ganglion," of the "Medizinische Chirurgische Encyklopädie," "It was soon made out that they must belong to the bursæ and synovial sacs of joints and sheaths of tendons." Other writers hold the same opinion with regard, at least, to the synovial sheaths, but it is strange that no English author among the many whom I have consulted, mentions their connection with joints, although it is perhaps as common as the tendinous origin.

The point to be now more especially examined, is the mode whereby such swellings can be formed from a normal synovial membrane. In every such sac there must exist a certain position of parts, in which the least space is given for its contents, and in which, therefore, such contents press upon the free and reflected portions of the membrane. Thus, if the sac belong to a joint placed in such a position, the fluid will be forced from between the articular surfaces against the free portion of membrane which unites the bones, pressing it with more than usual force against the restraining ligament, until some part of it being weaker than the rest, or being opposite a little mesh or cranny between the fibres of the ligament, becomes stretched and pushed back, either into the synovial tissue, or into such a lacuna of the ligament itself. The same thing may, of course, be said *mutato nomine*, for tendinous sheaths. The joints in which such actions are most likely to take place, are those having large articulating surfaces, and small reflected portions, which act as *diverticula*. When such a knuckle of membrane has, as above described, been pushed out, it withdraws itself more and more, until it forms a cup which constantly secretes and receives fluid from the general cavity, till it becomes distended into a globular excrescence or hernia from the synovial membrane. This protrusion is at first very minute, not so large, perhaps, by half, as the head of a pin, and it may remain always of this size, having still a small communication with the synovial sac, and appearing simply as a little addition thereto. Such appendages have been found connected with various joints, the knee, the shoulder, etc., but above all with the carpus. I have also found them at the astragalo-scaphoid. They have been described as normal structures; M. Gosselin, of the Hôpital Cochin in Paris, draws particular attention to them, and giving them the long name of synoviparous crypts, describes them as destined to increase the amount of secreting surface, and as occurring not only in man, but in animals also. He went to the abattoirs of Paris, and there examined the carpal and tarsal joints of a good many horses, and found synoviparous crypts in them. Yet, in spite of all this evidence, I do not believe that the normal condition is the existence of these

sacs ; because the physiological reason given for their presence is inadequate. Let us consider, for instance, the synovial membrane of the carpal joints, which is so extensive that it lubricates not only the joint between the two carpal rows, but the junction between each pair of bones, and the four inner carpo-metacarpal articulations as well. I say, when we consider the size of this membrane, and the extent of its secretory surface, we shall not readily believe that it can be materially assisted by five or six follicles not so big as pins' heads. Then, again, I have examined many carpal joints, and must acknowledge that, if we take our subjects from the dissecting-room or hospital dead-house, we shall in all probability find synoviparous crypts. Such persons are usually somewhat beyond middle age, and have led hard-working lives, but if we take our examples from the hands of children, no such structures will be found. The hands of ladies, who have in their lives done nothing severer than worsted work, come seldom under examination, but in one that I had the opportunity of dissecting, I found no synoviparous crypts, although I studied the whole membrane with a glass. Again, there is a class of women whose mode of life and poverty combined often bring them to the hospital, although their hands are free from the signs of labor : in these, synoviparous follicles are absent. Lastly, they are more common on the right hand than on the left. Indeed, we may take the condition of the skin of the hand to represent the probability or improbability of there being any such excrescences ; therefore they are, I believe, abnormal, the result of hard work, and straining of the joints, and they occur in the place where we should expect such results to appear,—namely, chiefly at the carpus, where the whole secreting surface is very large, and where the portions reflected from one bone to another (which act as diverticula) are small. Moreover, when from certain positions of the joint, the fluid becomes forced into that space, and presses against the synovial membrane, it must take most effect upon that portion of membrane which is least supported by ligament ; and this is just at the angle of reflection, where the membrane leaves the bone. It is at that spot, therefore, that we should expect to find most frequently the results of over-exertion, and it is here that we really do most frequently find synoviparous crypts. As for the animals which M. Gosselin examined, it must be remembered that they were omnibus and fiacre horses, which, after a life of severe labor, had been condemned to the knacker, and therefore creatures on whose joints we should expect to find the results of overwork, as M. Legouest has observed.

The little processes, then, which are found projecting from synovial membranes are not physiological, but pathological formations, produced by a pressure from within, as previously described. They are at first almost microscopic, and may be best seen by examining the inner surface of the membrane, on which (causing it to protrude) they create a slight pit, generally with an orifice in its centre. One of these excrescences, which shall have passed into a mesh of the capsule, may increase considerably until it protrudes through the fibrous structure, forming a tumor on its outer surface. The channel of communication with the original sac may still remain open, or it may have closed, leaving only an imperforate cord passing through the ligament, and connecting the cyst with the synovial membrane ; or, lastly, even this cord may have disappeared, so that all means of tracing the origin of the cyst are lost, and it appears like a new formation. In a hand, which I dissected during the winter of 1857, I found on the first phalanx of the ring-finger an oval tumor, not so large as a horse-bean, the long axis of which corresponded to that of the finger. It was of an amber color, and adherent by a small point to the fibrous sheath. I removed the

sheath with, of course, its lining of synovial membrane, and found, on looking at its inner side, a small opening, through which a bristle could be passed, whereby it was shown to communicate with the interior of the tumor. I endeavored to preserve these parts in spirit, but the semi-fluid contents of the cyst were soon dissolved ; in endeavoring to pass a bristle through the narrow opening to act as a spring in the tumor and distend its walls, I unfortunately used a little too much force, and broke it away. This hand had belonged to a coachman, and bore many signs of rough work. The palmar fascia was in one part scarred and contracted into a thickened cord, which prevented straightening of the middle finger ; and there were three synoviparous follicles at the base of the os magnum. In hands of this sort, cysts, as above described, are not very rare. I have seen one on the sheath common to the extensor ossis metacarpi and extensor secundi internodii pollicis. This was bilobular and extremely tense ; the peduncle connecting it to the above-named sheath was very thin and imperforate. I have also seen one at the back of the carpal bones, connected by a stalk to the joint between the scaphoid, semilunar, and os magnum. I have seen one lying unconnected at this spot. In fact any one, who carefully examines a number of hard-worked hands, will be sure to find such tumors in different stages of progress, from the first simple bulging of the synovial membrane, to the cyst lying free among the tendons and upon the ligaments. Such a cyst increases, being distended by its own secretion, while its walls become thickened by a fibrous layer, either derived from the structures through which the tumor has passed, or acquired by the constant friction to which its prominence exposes it, until the growth becomes round, hard, and elastic, rather than fluctuating.

Ganglia may occasionally be cured by counter-irritation, iodine, or other such application, but in by far the greater number of instances they will not yield to such treatment, and something more decided must be done. There is generally, in these cases, an amount of vague fear as to the effects of any treatment which arises, I believe, from the evil result produced in a few instances, in which the sac of the ganglion still communicated with a joint, and as this condition has not generally been understood, it is evident that certain cases would, energetically treated, end disastrously. It is highly important to ascertain the true condition of the cyst, because we may use, upon an independent one, treatment that we dare not apply to one still in connection with a joint-cavity. The mode of making this distinction is by pressing on the cyst, and observing whether it becomes slowly reduced, and whether, when this pressure be removed, it will as slowly reappear ; if so, the reduction is of course due to the passage of fluid into the normal synovial cavity ; if, as sometimes happens, the tumor vanish suddenly, and return as quickly on the application and suspension of pressure, this reduction is *en masse :* the whole cyst has slipped under a ligament or some other fibrous structure in the neighborhood. The greater number of these swellings are not in any way altered by pressure.

If by these means the entire independence of the cyst have been established, some mode may be adopted to produce its evacuation, and the subsequent absorption of its walls. The old plan of striking it forcibly with the back of a book or other hard object, is barbarous in the extreme, and I have known it productive of evil consequences ; the same may be said of rupturing the cyst by pressure with the thumbs. I have frequently emptied the cysts by a subcutaneous section with a small tenotomy-knife, dividing their walls freely from side to side (occasionally I believe I have cut them quite in half), and then applying a splint with considerable pressure over the part. The following is a good mode of using a pad or splint, so as

to obtain the greatest amount of pressure. A strap is fastened by brackets to the splint, allowing a certain amount of movement up and down ; the strap carries a metal plate with screw-holes, and a screw presses upon a pad placed over the ganglion. Undue pressure upon the rest of the wrist is prevented by the breadth of the splint and thickness of the pad, which does not allow the strap to touch the skin anywhere, being lifted away by the screw.

Sometimes even this is not sufficient, and then such a cyst may be injected without fear. Tincture of iodine and water, one part of the former to three of the latter, appears to me the very best possible injection : in using it we should endeavor to empty again through the canula the same quantity, as nearly as possible, as was injected, but much manipulation and kneading are to be avoided.

There is a form of this disease, situated about the popliteal space, which is very important, not because the malady is severe, but because any error in diagnosis may lead to disastrous consequences. This is a gangliform or thecal enlargement near one of the flexor tendons, more commonly near the inner ones ; though I have seen it at the biceps, and even near the middle of the space. The tumor is ovoid, fluctuating, and evidently cystic ; in some cases about the size of a hazel-nut, in others as large as a hen's egg. The cyst is sometimes an outgrowth from one of the tendinous sheaths, sometimes an enlargement of a normal bursa ; but has frequently a deeper origin, being a protrusion of the synovial membrane of the knee through one of the openings in the posterior ligament. If the track of communication between the tumor and the normal cavity, whatever it may be, have become closed, it is impossible to diagnose the origin of the sac. If, on the other hand, this track remain open, the diagnosis not only can, but must, be made, since treatment applicable, if the enlargement be merely an offset from a tendinous sheath or a dropsical bursa, is inapplicable if it be a diverticulum from the knee-joint.

The cases appended to this chapter will help to elucidate the mode of diagnosis, the chief principle of which is to observe whether the tumor can in any degree be emptied or rendered flaccid by pressure. If so, we must try to discover into what sac, bursa, or sheath, the fluid thus squeezed out has passed ; or, at least, whether it passes into the knee-joint. Firstly, such intercommunication may be strongly suspected if the knee-joint be affected with hydarthrosis, or the earlier stage of arthritis deformans. I have never seen such a communicating cyst when the knee-joint was perfectly healthy ; though, in one case, the morbid condition was simply a slight excess of fluid, with knocking of the patella, etc. If a small cyst can be emptied by pressure, the fluid, should it pass into the knee-joint, will hardly increase the size of so large a bag, but the fluid from a more considerable cyst will do so. When pressure is removed, the tumor begins slowly to fill again. By squeezing the anterior and lateral surfaces of the knee, the rate of increase can be usually greatly augmented ; or, again, if the cyst be again filled, and the surgeon once more try to empty, while an assistant grasps and compresses the knee, he will find considerably more resistance than previously, when the joint was free. If the assistant suddenly remove his hands, an easier flow will be verified. Lastly, although the contents of a small cyst will not perceptibly augment the bulk of the knee-joint synovial membrane, it will, if it communicate merely with a theca or bursa, usually cause during its decrease the enlargement of the primary sac.

Case LXXII.—Joseph G., aged twenty-seven, came under my care with a tumor at the back of the knee-joint. The man had been for about six

weeks walking a great deal. The knee itself was rather full, the patella knocked and the synovial sac fluctuated; the man complained of no pain, but said that his knee got easily tired and felt heavy. On the outer side of the popliteal space was a tumor about the size of a partridge's egg—fluid and evidently cystic; it lay inside the biceps tendon, not far from its insertion. Some pressure on this tumor emptied it slowly; it was seen to be considerably smaller, and then to slowly increase. By pressing on the patella, front and sides of the knee, the cysts filled more rapidly. I treated the man simply for subacute synovitis, and when the synovial membrane became only normally full the cyst was barely perceptible, and the man was advised to leave it alone, since it caused no inconvenience.

Case LXXIII.—John S., aged forty-nine, was seen by a very excellent provincial surgeon at the end of January, 1880, who found a considerable pulsating tumor in the popliteal space, bearing all the signs of aneurism. He sent the man to me.

February 2d.—The middle of the popliteal space was occupied by a fluid tumor, which pulsated markedly. I let the femoral artery be occluded at the groin, and found that, by pressure, I could empty the sac. But when the artery was released the tumor did not refill with that sudden spring so marked in popliteal aneurism, neither was the pulsation quite expansile enough to impress my hand like an aneurism, and though the whole tumor pulsated, yet the beat was strongest in a line along its centre. When the sac had refilled I again tried to empty it, this time without any pressure on the artery, and found that I could do so as easily as when the blood-stream was stopped.

The knee was slightly hydropical, and although not larger when the popliteal sac was emptied, was certainly more tense. Refilling of the cyst was considerably accelerated by pressure on the knee-joint.

I directed a leather splint to be so moulded on the outer side of the limb, as to avoid the popliteal space, as I wished to watch the tumor. Leg to be swung in a Salter's cradle.

February 4th.—Pulsation only perceptible along the course of the artery, which appears rather near the surface. Flying blisters to knee.

February 7th.—No pulsation anywhere about the popliteal space. Tumor much diminished.

February 23d.—Knee and popliteal space quite normal. Discharged.

Case LXXIV.—Edward E., aged twenty-nine, consulted me November 3, 1878, on account of a round tumor just outside the semitendinosus tendon, and lying on the inner head of the gastrocnemius. The knee was normal. He had, during August and part of September, done a good deal of Alpine climbing; the lump had made its appearance about the beginning of October, and had gone on slowly increasing. A surgeon in Paris had wished to lay it open, but he preferred returning to England. The tumor was globular, movable, fluctuating, and evidently a cyst. I tried ineffectually to empty it by pressure with the hand, also with an elastic web-bandage and thick pad. In spite of all efforts it remained the same. I told him we would try strong tincture of iodine, but that I did not expect it to have much effect.

November 25th.—The tumor was perhaps rather larger. I advised him to leave it alone, but he was desirous of its removal. After trying again uselessly to empty the sac, I passed in a tenotome, and under the skin made complete section of its walls. About a drachm of the transparent jelly, which is found in ganglia, escaped. Strong pressure with pad and bandage was applied.

No symptoms followed. I saw him four months after, and there was no sign at all of his having had anything wrong with the limb.

CHAPTER XVII.

ON HYSTERIC PSEUDO-DISEASE OF THE JOINTS.

Pathology.—Among diseases whose pathology is most difficult, hysteria takes a high place, not only because it occurs under such widely different circumstances, but also because of its multifarious manifestations. There is anomaly in its very name, for it occasionally presents itself in the male sex; and this misnomer is not one of words merely, for I believe it frequently occurs in women, without owing its origin in any way to the uterus or other organs of sex. It is well to consider this latter proposition most carefully, for certainly much harm is constantly done by determinedly referring all so-called hysterical symptoms to an irritability of the generative system, and in ignoring other circumstances and conditions which would be at once perceived, and whose influence would be immediately acknowledged, if this fixed idea did not too much occupy our thoughts. Now hysteria may appear under a great variety of forms; and, as is well known, has a very strong tendency to imitate a vast number of diseases; but for our present purpose, and indeed for its whole pathology, it will suffice to divide it into two classes; firstly, Hysteric Paroxysm; secondly, Mock Disease; and to observe the circumstances under which these usually occur.

The Hysteric Paroxysm, or fit, is apt to come on under any excitement, whether or no there be present any traceable uterine disturbance, such as amenorrhœa, dysmenorrhœa, etc. An emotional woman may at any time be liable to such paroxysm; but it is certainly more common in those whose uterine functions are badly performed, or in whom any temporary irritation exists; for instance, many women, who ordinarily are in nowise hysterical, always suffer from tendency to such attacks, when with child. Again, prostitutes are peculiarly liable to the hysteric fit. In these instances a generative irritation is easily traceable; but such paroxysms occur to persons in whom no such cause can be found; this is hardly a case in which the dogma "*de non apparente et de non existente eadem est ratio*" will hold, although, practically, we must assume it. We never can look so closely into the life of man or woman as to assert that no outward cause of disappointment or excitement may not have its influence.

The slower and more obstinate form of hysteria, which assumes the shape of some other disease, is, I believe, frequently unconnected with any traceable disturbance of the uterine functions. A great number of such cases have come under my notice, and comparatively few of the patients have had any such disorder. It is rare that both manifestations of hysteria, viz., the paroxysm and pseudo-disease, are co-existent; patients who suffer from the one do not, as a rule, suffer simultaneously from the other; but it is not unfrequent, that when the fits disappear, a mock malady comes on the scene; and this latter is sometimes dispelled by a violent paroxysm.

No period of life, after puberty, is exempt from the liability to hysteric pseudo-disease, and indeed my experience has led me to the conclusion

that women, especially unmarried women, over forty-five years of age, yield a larger percentage of such patients than is afforded by women under twenty-eight. There is, too, this difference in the form of malady assumed: the more juvenile hysteria imitates as a rule an acute malady, or, to say the least, one of rapid advent, accompanied by severe pain, probably more or less paroxysmal; the pseudo-disease of more advanced life simulates a chronic slowly increasing malady with continuous wearing pain, which is seldom described as agonizing or intolerable. The younger patient will either give in at once, refusing to move the limb alleged to be paralyzed or painful, or else she will make strong efforts to fight off the malady and truly endeavor to get well. The older sufferer is apt to be constantly thinking how she may spare herself certain movements, what contrivance or piece of furniture, or what additional domestic may be useful. A woman affected with this sort of hysteria, especially if she be in circumstances that will enable her to add almost daily this or the other little thing to her comforts, will not get well very rapidly, even if she ever do so, but her troubles may often be mitigated. We must, however, remember, although the particular disease, be it spinal weakness or diseased joint, may be hysterical, that at the age in question some real trouble, such as kidney derangements, indigestion, the discomforts of flatulence, etc., often coexist. The younger patients very frequently get well almost as suddenly as they became ill.

One of the means whereby restoration is occasionally, though by no means always, brought about, is marriage. Sometimes the benefit is permanent: in other cases severe hysterical manifestations occur during the last three months of the earlier pregnancies, but at no other time. In some persons hysteria will recur when the period of child-bearing has ceased. Women who during virginity have been hysterical, and who in wedlock bear no children, may be free of the disease for a year after marriage, rarely for three years; recurrence in an aggravated form nearly always then takes place.[1]

Women who begin to be hysterical at an unusually early age (fourteen or fifteen) and remain unmarried, usually get well after the thirty-fifth year, rarely sooner.

Thus, when we come across any case of hysterical joint disease, it behooves us well to consider all the characteristics of a general malady presented to us by a woman perhaps in all other respects perfectly healthy. It is not, I conceive, right to suppose that these patients wilfully deceive themselves, their nearest relations, and their medical attendant; but at the same time we cannot for a moment imagine that any local disease is present. The malady is centric; the condition, which first conjured up in the mind an idea of local pain, probably originated in an irritation reflected from other organs. The disease fluctuates with the various phases and states of the uterus, whether of excitement, repletion, or disappointment. The patient, however, believes her sufferings real and local, although she feels undefinedly that she can call them forth or repress them, until, pleased at exercising this indirect power, at exciting the pity or exacting the attention of her friends, she may come, in the later stages of the disease, to delight in alarming and tyrannizing over all her surroundings. Yet there are great varieties in the condition. To some hysterical patients the malady is a means of power, furnishing an invincible negative to every proposition

[1] All the cases who form the basis for these axioms had sufficiently marked hysteria during maidenhood.

displeasing at the moment. To others the suffering is as real as though disease were actually present.

Symptoms.—The joint-affection, the mere local manifestation of the malady, is of no importance except so far as it is of moment to distinguish it from a real disease ; a mistake either way may lead to disastrous results.

In the first place it is necessary to disabuse our mind of the idea that a uterine inflammation or menstrual disorder lies of necessity at the root of this evil, but it is our duty to distinguish between the cases thus connected and those having no such cause. In some instances the menstrual function is more or less disordered ; in some the patient has been in the habit of having hysterical paroxysms and globus hystericus, which ceased before the pseudo-disease came on. In other instances there is no derangement in those functions. In the first place we recognize a case markedly hysterical ; in the second, one wherein the uterine origin of the disease may still be active, and may keep up the condition of nerves whereon the malady depends ; in the third, the conditions mentioned in the last section (p. 340) must be carefully studied.

In an affection confessedly so variable as this, it would be futile to endeavor to give any account of all the symptoms to be observed in a large number of cases ; but two peculiarities may be fixed upon as especially characteristic of the hysteric joint ; these are anomaly, and the absence of the ordinary signs of inflammation. In estimating the former it is essential that the surgeon be perfectly acquainted, not only theoretically but practically, with all the symptoms of the various sorts of joint disease, otherwise this characteristic will escape or only puzzle him. With regard to the latter we will shortly examine which of the four signs of inflammation, viz., pain, heat, redness, swelling, are, by their absence, most influential in establishing the diagnosis. The first is to the patient a subjective symptom ; it is one which does not present itself in any way to the senses of the surgeon, and he has to take the affirmation of the sufferer in regard to it more or less upon trust, and it is in this very symptom, therefore, that he chiefly finds the statements of an hysterical patient varying with actual fact ; it is in this peculiarity that anomaly is betrayed.

Heat is an important symptom when it occurs in real joint disease, but it is not always present ; its absence, therefore, becomes less important in the pseudo-malady. A surgeon, when he first sees his patient, will frequently find the affected joint wrapped in flannel, irritated by stimulating liniments, perhaps blistered, or even the seat of suppurating issues ; all these add very much to the difficulty of the diagnosis, and if the last conditions be present he had better defer giving a decided opinion until the normal state of parts has been restored. In cases not thus complicated a few minutes' pause, after uncovering the part, while the patient is engaged in conversation, will allow the limb to return to its natural temperature, if heated by flannel or other wraps. An hysteric joint is not hotter than the opposite unaffected one ; indeed, it has often appeared that it gives a sensation of greater coolness. I am unable to give any thermometrical proofs of this fact, nor do I believe greatly in their value when applied to mere surface manifestations of heat and cold. For there certainly are many surface conditions of all bodies, which, without affecting a thermometer, give a very different idea of heat or coldness to the hand ; some such condition is always present in inflammatory joint disease, and always absent (unless it have been artificially produced) in hysterical mock disease.

Redness is, as we know, frequently altogether absent in real joint-maladies, particularly if the inflammation be in a deep joint, and if it be of the

strumous character; its presence or absence, therefore, is of little avail in determining the true or false character of any particular case; but it is right to mention, that in certain instances of the hysteric disease there is frequently a capricious and transient blush upon the surface, pinker in color and evidently more superficial, than the dull hue which, when redness accompanies real joint disease, appears to lie deep beneath the skin.

The fourth inflammatory symptom, *swelling*, is one which may have been produced by mistaken irritation. An hysteric joint is not swollen (unless artificially); there may be slight puffiness or œdematous enlargement on the surface (subcutaneous), but this is a very different thing to the appearance of effusion into the joint or deep-seated thickening; it may more resemble inflammation of parts external to joints; but then, many symptoms related in the foregoing chapter, namely, circumscribed swelling and tenderness in the known situation of a bursa or tendinous sheath, are absent.

We will now examine the different forms of anomaly, the mode of detecting it, and its value in different joints; only premising that we have already discovered an important one, namely, the presence of pain in or about a joint without any other clear symptoms of inflammation; there may be some attempts as it were to imitate these latter, but on examination they are all found to fail; let us see if pain can hold its place against a careful investigation.

The articulations most likely to be affected by this malady are the hip and the knee; other joints are occasionally attacked, but more rarely, and the reader may easily transfer the account of the diagnosis, in one of the two instances to be described, to a case of suspicious disease in another joint. Hip-joint disease produces, as we know, in its second stage certain deformities dependent in part upon actual organic alterations; in part upon peculiar contractions of the abductor muscles produced by the local irritation. It is partly in the mode of placing the limb that we shall find variations from the usual methods in joint disease, which may first of all render the case suspicious. On examining the patient, who generally will be found in bed, we shall first observe that the pain complained of is tolerably diffuse over the whole buttock of that side; it is probable that pain in the groin will not be mentioned (commonly absent at the beginning of hip-joint disease), but if it be so it will be also somewhat diffused, and has considerable tendency to locate itself above rather than below Poupart's ligament. Moreover, tenderness is, as Sir B. Brodie has observed, "very severe upon the slightest pressure or even contact;" indeed, the patient shrinks almost before she is touched, and if the surgeon magnify his commiseration for this pain and his fear of increasing it—if he suggest pain as being present in different parts—he will cause the patient to confess it anywhere. Thus it is very important that an attendant, seeing for the first time a young woman with a suspicious joint-malady (particularly hip or knee), should not put such leading questions as shall enable her to shape her answers accordingly, and thus to make up a good imitation of real disease; rather he should endeavor to put the question so as either to leave her entirely to her own resources for a reply, or so as to suggest to her an answer manifestly incongruous. I do not mean to indicate intentional deceit; such a case would be simply one of malingering; the patient nearly always deceives herself more than her surgeon, who should avoid giving her self-deception a definite direction by suggestive or leading questions. In an unsophisticated case pain and excessive tenderness is not confined to definite parts, and it will be so acute that the patient cries out more when the skin is

touched, than when a firmer and deeper pressure is made. The sort of pain complained of is on or near the surface, is more like that of a neuralgia than a joint inflammation; but it does not run in the course of the nerves; it is frequently said to keep the patient awake, but it does not wake her; it very rarely happens, if ever, that pain simultaneously affects the knee, and pressing or knocking upon the sole of the foot does not produce any pain at the hip. If the patient's attention can be engaged by conversation or other means, while the examination is going on, the parts previously tender can be manipulated without producing signs of pain. Moreover, if, under like conditions, *i.e.*, the patient's thoughts engaged elsewhere, the surgeon grasp the ankle and move the limb in its various directions, he will not find that the pelvis follows the thigh, as described at p. 294.

It has been shown (Chapter XIV.) that the changes in length of the limb are due, in real hip disease, to position. The usual course is that at first an apparent lengthening occurs, which is soon followed by shortening, and there is always a certain though an indefinable proportion between these alterations and the intensity of the inflammatory symptoms. In the hysteric pseudo-disease shortening is nearly always the first change, and this is disproportionally great in regard to any inflammatory symptom; and what renders this condition still more valuable, as a means of diagnosis, is its variability. To estimate these appearances fully it is necessary that the patient be made to stand up; the surgeon seated behind her will observe that the pelvis on the side of the pain is tilted up and drawn backward in the same way as in true hip disease; but the spine is much more twisted, the nates on that side are protuberant, and the muscles tense. Let the patient remain standing some considerable time, and be engaged in answering questions having no especial reference to the place of the disease nor to the pain, and the forced position becomes less and less marked, until it is nearly natural. But a remark directed to the hip, or a hand laid upon it, will instantly bring about a resumption of the mal-posture. Again, whether the patient have assumed one or the other position (lengthening or shortening), the swelling cannot, although the flaccid condition of the nates may, be imitated. We have previously called attention to the obliterations of the fossa behind the trochanter, to the deep swelling in the groin below Poupart's ligament, and to the wasting of the thigh (p. 301). One or all of these are always present in real disease when deformity sets in. They are the only points[1] in form and outline which cannot be imitated by hysteria. If to these signs be added the absence of that expression of suffering and anxiety, which is, always more or less, frequently strongly marked in coxitis, the surgeon will have no difficulty in detecting the true nature of the case. Patients affected with hysteric hip disease have generally a healthy appearance, sufficient embonpoint, and good appetite.

In an imitation of knee-joint disease the pain complained of is often very severe—disproportionally so to the amount of local disturbance, which at first glance appears; it may keep, or be said to keep, the patient awake at night, but it never wakes her when she is once asleep. The limb will generally, while under observation, be held perfectly still and semiflexed in the same position as is taken in real disease, or the patient may still walk, but with limping, and signs of suffering; the pain is referred to a spot on each side of the *ligamentum patellæ*, and is increased on the slightest touch, particularly if a piece of the fatty cushion, there situate, be gently pinched between the finger and thumb. Such mode of manipulation, indeed, appears

[1] Except the late events of hip disease.

to cause more pain than a pressure exerted by the broad surface of two or three juxtaposed fingers, and gradually increased so as to influence the deep parts. There is seldom pain or tenderness above the patella, and if this bone, grasped at its upper part, be moved backward and forward between the femoral condyles no tenderness is complained of. In those cases, in which the joint is kept rigidly semiflexed, the surgeon should endeavor with slight force to straighten the limb, keeping his hand at the time upon the hamstring muscles. He will then feel these act strongly with active contraction, which will communicate to his hand a sensation utterly different to the passive retraction of muscles which follows a long-standing disease of the joint. In a case of doubt, chloroform is a most useful aid to diagnosis, which fact I believe myself to have been the first to point out, in a paper read before the Medical Society in 1858. Under its influence perfect mobility, as of an entirely healthy joint, will be restored. The above signs, with absence of any swelling or thickening of the deep parts, and of the other inflammatory symptoms, as already mentioned, will fully suffice for diagnosis, particularly if measurement show no enlargement of the joint.

There is a point which I have known to mislead in diagnosis, viz., a certain crepitation in the joint complained of. Now, many boys, as well as girls, arrived at puberty, or at the period of rapid growth, are subject to a peculiar crackling at the joints, chiefly the knee, hip, and maxillary articulation. This is quite painless under healthy circumstances, and children frequently amuse themselves with the odd sensation it produces. But if the individual be a girl, who, verging into puberty, becomes weaker with chlorotic tendency, this crackling is very apt to continue in one of the joints, and at last to become the secondary cause of a neuropathy fixing itself in a certain part, and gradually assuming the character of an hysteric joint. Thus, then, we may find in such a malady a certain amount of crackling, comparable to rubbing together two surfaces of parchment, of coarse silk, or of crape, and which is not like any of the crepitations in joint disease, except an early stage of hydarthrosis.

Occasionally, though rarely, hysteric pseudo-disease of a joint goes so far that a sort of imitation of "starting of the limb" comes on, of which in some cases the patient complains, as causing great pain, and which in others is perfectly painless. No surgeon will for a moment mistake this phenomenon for the starting-pain, whereof so frequent mention has been made in previous chapters; but the differences are worth recording, if merely for their curious physiological character when regarded in connection with the true symptom. In most cases the hysteric movements only come on when some one is present; though the patient may affirm them to be constant, which they rarely are. They are rhythmical, sometimes recurring with immense rapidity, sometimes synchronous with the pulse. But the circumstance most worthy of note is, that they cease during sleep, even before consciousness is altogether lost, and they do not return until the patient is fully awake in the morning. Now, the starting of the limb from articular inflammation is always worst just as the patient sinks to sleep, when the controlling power of the will is withdrawn. This difference in the time of occurrence marks their several origins—the one is dependent upon the cerebrum, the other, independent, even requires the withdrawal of its power.

Treatment.—This malady has attained an evil notoriety, as the *bête noir* of medical practice, and nothing can be more fatiguing than the constant iteration of incongruous pains, the unvaried ringing of monotonous changes, concerning this sensation and the other, which certain patients insist on forcing upon us. The weariness which the subject creates, may have led

us too much to pass over hysteria as a malady connected with some ill-defined, often undiscoverable uterine disorder, and to order at once some set prescription of tonics and emmenagogues. But if, as we have seen, there be two conditions in which a mock disease may occur, we ought to distinguish one from the other in our mode of treatment; even the form which appears to have begun in a uterine affection, but in which no detectable disturbance of that organ remains, must not be treated as though such condition existed. The so-called hysterical joint disease frequently presents itself in the persons of strong florid girls, troubled with no menstrual disorder or leucorrhœal condition, and I am sure that cases have presented themselves to me in which the administration of iron, aloes, and other such medicines has been injurious. When, on the contrary, any such disturbance is present, it is to be subjected to the recognized methods of treating the particular form of the complaint. In most cases the best physical management is a combination of such hygienic measures as exercise, cold baths in the morning, a non-stimulating diet, etc.

The most important part of the management is, however, rather mental than bodily, and depends upon the amount of control which the surgeon can exercise over his patient and her friends. Having verified securely his diagnosis, he must enforce obedience to his ordinances, whatever they may be. Great caution and power of judging character are necessary, that he may ensure faith; and considerable firmness, in insisting upon the performance of anything he may command; for if the patient once overcome him, he will scarcely ever regain control. In some cases, even when the patient has been in bed for weeks, perhaps months, one can make her get up and walk about on the first time of seeing her; in others, one may have to be a little less peremptory, though equally determined. If the person be possessed of good sense, and of a real desire to recover, it may be well to explain the absence of all organic disease, and the necessity of exerting her own will to overcome her sense of pain. At the same time, in all cases, relatives or other surroundings must be cautioned against yielding to any signs of invalidism, or any attempt at lying by to be nursed and petted.

Sometimes we may endeavor to interest the patient's imagination, and draw it away from the spot whereon it has fixed. For this purpose I have, in some instances, made use of an expedient which, I believe, will often be found useful in cases where the patient's confidence rests fully in the attendant, and some real desire to recover exists. The value of the plan lies in calling the person's mind away from the affected spot of the body, and establishing a firm belief that when a certain event takes place the pain will cease. I have used a seton of a single thread, passed through a small fold of skin, at some considerable distance from the seat of pain, and have endeavored to make her firmly believe that when the silk comes away the pain will leave her. Such a method of practice is often successful; it appeals directly to the mental function really affected: the difficulty, however, is to create a sufficiently firm belief in anything so plain and simple. It should be particularly observed that any application to the part itself is injurious, as tending still more to fix the patient's attention upon that locality. Leeches and blisters have often done almost irreparable injury. The medicinal treatment of pseudo joint disease is by no means satisfactory—if any derangement of the catamenia exist it should be eliminated by the proper means, especially should too frequent and too copious a discharge be regulated: the chlorotic patient should have iron and tonic regimen, the sanguineous and plethoric a contrary treatment. Two medicines have more especially gained some repute as having an influence on the

neurotic basis of hysteria, viz., valerian and bromide of potassium. These may be given combined in the same mixture (Formula XVIII.), or the former may be administered in the form of the valerianate of zinc, with or without a tonic (Formula XIX.). A third medicine, asafœtida, though it may influence paroxysmal hysteria, seems to me devoid of any power over pseudo-disease. The tincture of sumbul, in such cases as are accompanied by flatulent distention of the bowels, is often useful, especially if aloes are being employed. The Indian hemp, where pain is a prominent symptom, and especially if the catamenia are profuse, is often valuable.

It is to be feared, however, that many cases of hysteria are obstinately incurable by what are called medical means; it frequently happens that when the patient has left us well and free from all such disorder, she will come back after months, or even after years, with other symptoms, but the same disease. Such will occasionally happen, although all the circumstances of life may have been changed in the interval. The patient, formerly a green-sick girl, will return an established matron, with three or four children; but affected with another manifestation of hysteria; and I have great reasons for believing, that persons who in their youth have been subject to hysterical manifestations, often though in middle life free from them, again suffer about the forty-fifth or fiftieth year. It must always be remembered that some persons are too much enamoured of invalidism ever willingly to consent to get well. Physical and mental hygiene, strong reason, good sense, often combined with plenty to do, are the best cure. Cold baths on rising in the morning, exercise, pure air, and cheerful amusements, are the best methods of combating the morbid state.

One joint, however, the sacro-coccygeal, is often affected by a very painful condition, commonly called coccyodynia, which in many cases is doubtless a pure neurosis, but which is sometimes, I believe, a real malady. The latter class of cases owes its origin to an injury, usually to a fall on the nates in the sitting posture.[1] Pain is instantly experienced, but after a few days' rest in bed so far declines that the patient gets up, and at first is able to move about pretty fairly. After a little, however, the pain recurs and increases, so that at last all movements produce considerable suffering; sitting on an ordinary chair becomes almost impossible.

My belief is, that most cases with this history are founded on a basis of real disease; that though hysterical neuralgia may be intermingled with objective conditions in some of them, others are entirely real, originating in a traumatic inflammation of the coccygeal joint and ligaments. In most of these cases examination *per rectum* will show the tip of the bone protruded abnormally forward, salient toward the intestine, even sometimes pushing its posterior wall forward. A little consideration of the anatomy of this part will show why so many movements are painful; the erector spinæ through the lumbar fascia, the gluteus maximus, the levator, and sphincter ani are all attached to it, so that sitting (by direct pressure), the erect posture, movement of the thighs, even micturition and defecation—all move this bone; and should its joint be inflamed or its attachments tender, pain must be and is produced.

In cases, therefore, which commence in such injury as a fall, more particularly if the apex of the bone be abnormally prominent toward the rec-

[1] It may be said that men are equally with women subject to this accident, yet do not afterward suffer in the same way, but it must be remembered that the tubera ischii in the male are much more closely approximated and afford far more protection to the coccyx.

tum, the treatment is to put the part at entire rest, an object which can be attained by an operation thus performed: the patient is placed in stone position, though it is hardly necessary to tie the hands and feet, if assistants can be trusted to hold the thighs flexed and apart. Then the surgeon, finding behind the anus the tip of the coccyx, and marking with his eye a spot a little in front of it, passes the left forefinger into the rectum, and holds with the thumb the back of the bone; through the spot of skin, chosen as above described, he makes a puncture with a rather long tenotome, taking care that a sufficient thickness of mucous membrane lies between the blade and his forefinger, which, serving as a guide, enables him to pass the instrument a little beyond the sacro-coccygeal joint; turning then the edge backward he divides all structures along the left side of the coccyx to the skin, where his thumb guides him; avoiding withdrawal of the tenotome from the puncture, he passes it along the front to the right edge of the bone, and divides along that margin; he then lets his knife travel behind the part, thus isolating it except at the tip; this part of the procedure he completes while withdrawing the blade, by pressing the soft parts a little to the left (the patient's left), and removing the knife almost in a transverse direction. Scarcely more than a drop of blood follows the instrument, if it have been kept close to the bone.

If the coccyx have been protruding toward the rectum, the surgeon may from that intestine press it back, which, if the incisions have been properly executed, is quite easy, the bone lying loose, unless, as it sometimes happens after an unusually severe injury, it have become anchylosed. This operation has in my hands proved successful in several cases. I have never seen it followed by any untoward result, and in only one instance has return of pain occurred.

Case LXXV.—Jane G., aged nineteen, a fine, well-grown girl, came into the Charing Cross Hospital, April 22, 1856, under the care of Mr. Hancock, for disease affecting the right knee, which had come on about three months previously. The joint was held semiflexed. She complained a good deal when the knee was touched, or when the surgeon attempted to flex it, or to straighten it. She usually kept it wrapped in flannel, but when this had been removed some time it was not hot.

The joint was not altered in form, except that the ligamentum patellæ was perhaps a little obscured from superficial swelling on each side of it; it was in this place that both pain and tenderness were most severe; the former, she said, kept her awake, but she confessed that it did not awake her when once asleep. Measurement of the knee showed it to be a little larger, both above and below the patella, than the other. This difference varied slightly during the progress of the case, but was always less than one-eighth of an inch below, and never amounted to a quarter of an inch above the knee-pan.

The joint had been blistered, etc. The whole case was suspicious. Menstruation was perfectly regular and natural, there was no leucorrhœa, she never had an hysteric fit in her life, nor could any confession be obtained of a feeling like *globus hystericus:* these circumstances, and the perfect rigidity of the joint, rendered the diagnosis a little difficult. Chloroform, therefore, was administered, and when she was under its influence the joint became perfectly mobile, without crepitus, or any morbid condition whatever.

It is useless to follow out the various medicines administered, the several plans tried, and their failure. The girl seemed to suffer more, and

was constantly begging that the knee might be taken out, an operation of which she had apparently heard. Accordingly, on May 17th, she was taken into the operating theatre, chloroform was administered, and Mr. Hancock made a long incision on either side of the knee-joint, through the skin only; these were then dressed, a splint was applied, and she was taken to bed again.

May 19th.—She said she had had no pain, except tingling in the wound, since the operation. She was informed that it had not been found necessary to take out the knee-joint, and that when the wounds healed she would be quite well.

June 17th.—There has been nothing further to record than gradual healing of the wound without return of the old pain. After she had been walking about the ward perfectly well for some days, to-day she walked away cured.

Case LXXVI.—M. C., unmarried, aged twenty-eight, a pale and rather anxious-looking girl, came to me August 21, 1858, on account of a slight bursal inflammation and swelling over the right patella, which was treated and cured in about ten days; but in a week after she presented herself again, complaining of pain in the other knee, just under the patella, and on each side of its ligament. The knee was quite cool. When the foot was pressed even forcibly upward, or when the patella was moved from side to side, if only the place to which the pain was referred were not touched, no expression of pain could be elicited. The joint was in every dimension the size of the other. The menstruation was regular but small in quantity; she had considerable leucorrhœa in the intervals; had *globus hystericus*. It was very perceptible that the tenderness was increased and spread over a larger surface, and that she flinched more at the monthly periods; she also confessed that she suffered more from the knee at those times. Quinine and iron, with some valerian, were given thrice in the day; iron and aloes, evening and morning, with the effect of diminishing the leucorrhœa and increasing the menstruation.

October 10th.—The general health had now considerably improved; but finding that the knee did not get better, I determined to try a means of making the patient's faith in a more visible treatment than internal remedies operate a cure. She was, therefore, told that blisters or other application to the knee would only do harm, but what was wanted was to draw the pain to another part, but that we must be sure to choose a time when her health was well enough to bear it. This latter phrase was added only to excite her curiosity about the remedy, of whose nature she was not told. It was contrived that for a time something should prevent this application, until she begged earnestly for it herself, and then she was informed that it was the passing a piece of silk through a part of the leg, and that as it gradually worked out she would be freed of her pain. A suture was then prepared, and considerable show of great care in the choice of the proper place was displayed, and then the small single thread seton passed through a fold of skin at the inner side of the calf. Minute directions were given about the way of dressing the little punctures, and the necessity of watching it. She came very often to tell me of the progress of the seton, and said the knee was certainly getting better; and at last, when the silk had come out, came to thank me, saying the knee was quite painless.

Case LXXVII. September, 1858.—Miss Mary L——, aged eighteen, strong and rosy, was removed two months ago from school, being supposed to have hip-joint disease.

The girl's aspect was from the very first suspicious, being much too

hearty for such a malady. She was lying on a couch quite dressed, and I sent her upstairs to bed, that I might fairly examine her. While lying prone, she kept the left thigh a little bent, so as to raise that knee from the bed; the spine, at the same time, was crooked. Severe pain was complained of all over the thigh, hip, buttock, and side, even to near the scapula. The tenderness was not at first so extensive as after prolonged examination. Made her stand up, I seated behind her; found the left side of the pelvis raised, the fossa behind the trochanter not at all obliterated, the knee in front of the other, and somewhat inverted. The position simulated hip-joint disease sufficiently closely, but the absence of all swelling was remarkable. On keeping her standing some time the position became less and less marked.

The menstrual functions were quite normal, nor did there seem any sign of bodily disease. I insisted upon her walking half a dozen times up and down without a stick. At first I took hold of her hand, and partly helped, partly forced, her to walk; afterward made her go by herself, which she did, at last, with hardly any limp, but half crying the while.

She had been put upon a strong diet, and was taking steel. I prescribed a less stimulating food: no wine; meat only once a day; cold bath in the morning; a little walking every day. Explained to the young lady's mother the nature of the case and necessity of using all her influence in preventing her daughter lying up, and recommended some interesting pursuit.

A great many battles had to be fought with this patient. Sometimes she would declare she could not get off the bed; but on one of these occasions she was left unattended to till she found herself capable of moving. At last, when she obstinately refused to put foot to the ground and the point was insisted upon by both her mother and myself, she had a regular hysteric paroxysm, and from that moment the case was more easy of management. She got well about four months after I first saw her.

Case LXXVIII.—Mrs. T., in carrying a rather heavy child, aged three and a half years, downstairs, slipped, and, thinking only of sparing the infant, came down heavily in a sitting posture, and with unbroken impetus. After a few minutes the shock and pain of her fall diminished. But on trying to get up next morning she could not move her legs nor back without severe pain. She kept her bed for five days, and, feeling better, got up. The pain was greatly diminished, and for ten days she hoped it would disappear; but after that time it became worse. She tried a great many remedies, local and general, but gradually got worse. Had to give up walking two years after the injury; was helped up and down stairs, and was leading the life of a confirmed invalid. She consulted me on February 6, 1879. Many of her symptoms seemed hysterical, especially the fact of increase of pain at her menstrual periods,[1] but she had no hysterical skin-tenderness. I found, on examination per rectum, that the tip of the coccyx protruded considerably forward, and that moving the bone, grasped between finger and thumb, caused great pain. The operation was proposed, and after some days' consideration accepted.

February 13th.—I severed the coccyx from its connections, and with great ease pressed it back. She passed an excellent night, freer from pain than for two years past.

February 20th.—Had no return of pain. I let her get out of bed in my

[1] Since these notes were written I have found this to be a frequent symptom, even when hysteria was certainly absent.

presence, merely helping her by taking hold of her hands ; she could stand without pain.

February 23d.—Let her sit on an ordinary chair with stuffed seat ; this position was also painless.

July, 1880.—This lady answered a letter I addressed to her a fortnight previously. Her note ends thus: "I have had no pain at all since the operation of the sort from which I used to suffer. I was very much afraid that after my confinement at the end of January it would return ; but my fears were, I am happy to say, groundless. I don't know what you did, as I was insensible and never felt any wound. I only know that whatever it was it has restored me to my family and to society."

CHAPTER XVIII.

ON THE RESTORATION OF MOBILITY AND CONFORMITY TO CRIPPLED JOINTS.

Preceding chapters have sufficiently shown, that inflammatory joint diseases, exceeding the mere initial phases, are apt to leave behind them certain changes of structure, certain thickening or conglutinations, which impair their functions and mobility. In the next few pages it will be our task to study the anatomical conditions and the distinguishing features of such causes as produce joint-stiffness or deformity; but I should like, previously, strongly to insist upon a matter which has been already mentioned, namely, the fact that many joints are allowed to become more restricted in mobility, and more displaced, than the necessity of the disease demands; that when inflammatory actions have declined and the consolidating processes are going on, the position and the range of movement demand from the surgeon the greatest attention and care. Posture has often been described as part of a curative course; it is not under that aspect we are now considering it, but simply as the means of causing a limb, which cannot be entirely restored to its healthy condition, to be as useful and as little obstructive as possible; and (this remark applies more especially to strumous joint disease) to cause the smaller amount of mobility, which can be secured, to lie in the most convenient portion of the normal arc. This, which in the after-life of the patient makes a vast difference, can be secured by careful adaptation of the means already pointed out (p. 128); their repetition here would be unnecessary, but it seems to me good again to insist upon them, because we do occasionally meet with joints, which, either from indocility on the part of the patient, or from want of proper supervision, have become stiffened in very awkward and inconvenient postures. Moreover, the stiffness itself is not infrequently more than the necessity of the case demands.

The manifold conditions which produce joint-stiffness have been so far discussed, that a mere enumeration and classification is here required. They are intra-articular, peri-articular, and adjacent.

The first are true and false anchylosis, distinguishable anatomically from the others by the fact that the joint-cavity is obliterated, in the former by bone, in the latter by a cartilaginous or fibro-cartilaginous material.

The second include all thickenings and retractions of synovial, of peri-synovial tissues, and of ligaments. The joint-cavity, though perhaps considerably diminished, still separates two cartilages of incrustation, which throughout their surfaces of contact are healthy, or nearly so.

The third form, muscular contracture and fascial shortening, is at a distance from the joint; it may indeed be produced, as by long maintenance of an unaltered position, without the coexistence of any joint malady; but usually originates in certain conditions, immediately induced by the neuro-muscular phenomena of articular inflammations.

Any one of these is rarely unmixed, but very frequently the one or the

other is strongly marked or predominant. By care in methods of examination, and by adapting those methods to the exigencies of each case, the different forms may without difficulty be distinguished.

Anchylosis (ἀγκυλόω, ἀγκύλος), in its primary signification, connoted the idea of a bend or angle ; but such modification of the term has taken place, that it now indicates fixity rather than angularity ; hence we often now-a-days speak of a straight or rectilinear anchylosis—a barbarism which convenience must excuse. The symptom, which by its excellence differentiates true anchylosis from all other forms of joint-stiffness, is complete and entire immobility ; but its completeness must be fully and unmistakably verified. Now, although complete fixity is very easily distinguished from freedom of movement, yet it is often very difficult to diagnose it from incomplete fixation, from very slight mobility ; and yet the distinction constitutes all the difference between a true anchylosis and other forms of joint-stiffness This difficulty is more especially marked, if the surgeon have to do with a joint, lying close to the trunk, as the hip or shoulder, or with an articulation, one of whose segments is very short, as the ankle or wrist ; while greater facilities are afforded by joints which, like the elbow or knee, lie between long limb-segments. Muscular contractions, be they voluntary, involuntary or emotional, frequently offer considerable impediments to diagnosis, especially if the organs be short, deeply placed, and inserted close to the capsule of the joint, as, for instance, scapular and pelvic muscles. But, on the other hand, in most situations, the surgeon may gain great advantage by watching the behavior of muscles, during his manipulations, and then, at another time, annulling their action by an anæsthetic, he may investigate the state of the joint unsupported by these retractions. Therefore, except in very simple unmistakable cases, no diagnosis, no assured prognosis, should be given unless the aid of insensibility have been obtained. Let not my exception of "simple or unmistakable cases" cover too wide a ground. To the young and as yet not greatly practised surgeon, many a case will appear quite plain and indubitable, which, to the widely experienced man, offers many a question to be carefully investigated, and many a doubt to be cautiously solved.

The easier examination of a joint like the knee, without narcosis, may be thus conducted : First, the articulation itself, its size relative to the other, the absence or presence of scars, the amount of their retraction or depression, and changes in the shape of bones, are rapidly comprehended —the history of the case is gathered.[1] Then the surgeon, taking the thigh in one hand, the leg in the other, tries, with moderate force, to bend the limb. The first attempt should always be in that sense ; because it is from flexor rather than from extensor muscles that resistance is to be expected. If no mobility, no change of angle, can be ascertained, he next endeavors to straighten the joint. During this effort he must not fix his attention merely on the angle, but also on the hamstring muscles ; if the fixity be due to false anchylosis or to para-synovial causes, the hamstring muscles will contract ; they will either firmly and rigidly tighten themselves, or they will twitch and quiver beneath the skin. The same observations, changing such names as hamstrings for biceps and long supinator, will apply to the elbow ; and in a less degree also to the wrist and ankle ; but at these latter the attachment of muscles to bones beyond other and subsidiary articulations, somewhat detracts from the value of their indications. Therefore, as four large joints, viz., shoulder, hip, wrist, and ankle, offer certain difficulties to

[1] We shall shortly see how this affects our judgment.

exact investigation, I will describe more minutely the methods of examination, only premising that occasionally, as at the full-grown hip or shoulder, the hand of an assistant is often advantageous.

Shoulder.—When this joint is anchylosed, the deltoid wastes rapidly; the arm usually hangs by the side; but can be abducted either by the patient's own efforts or by the surgeon's. This abduction may depend entirely on elevation of the scapula, the shoulder-joint itself not moving in the least, even though there be no true anchylosis. It is necessary that the surgeon ascertain the place where mobility occurs. He should stand behind his patient, and in case he be about to examine the right shoulder, take the elbow, with the forearm bent rectangularly, in his right hand; then place his left palm on the acromion, let his fingers lie in front, on the neck of the bone, his thumb, sinking under the scapular spine, rest on the head of the humerus behind. This left hand serves to fix the scapula, to feel for motion of the head of the bone, and by gliding the fingers lower, to detect muscular twitching; while the right hand is used gently to raise the elbow a little from the side, to circumduct and then to rotate the limb. Cases, in which only a very slight amount of motion at the joint occurs, are often very difficult to distinguish from true anchylosis. I have found that by making deep pressure under the outer part of the acromion, by sinking the finger between that process and the head of the humerus, and then lifting the arm from the side while the scapula is fixed by an assistant, gives the most accurate means of detecting slight movement in the shoulder-joint.

Hip.—To examine the hip, the patient should be placed supine; it will probably be found impossible to place the back of the thigh on the table without raising the loins (see p. 299); the surgeon standing on the diseased side uses the right hand to move the right limb, the left for fixing the pelvis.[1] Firstly, to try if a flexed hip can be at all straightened, the left palm (about the first finger-joints) should lie on the anterior iliac spine, and the parts immediately beneath it, the fingers resting on the flank, taking care to glide the hand downward as low as possible, so that the outer border of the palm presses well into the angle between thigh and body. The thumb lies on the dorsum ilii, above the great trochanter, and grasps the bone as firmly as possible. This hand thus lies in the most commanding position for steadying the pelvis, and is also well placed for feeling with its margin any contraction of the tensor vaginæ femoris, the sartorius, and, if the abducted index be placed on the limb, of the rectus, while the right hand, grasping the thigh just above the knee, endeavors first to bend the limb, then to straighten it. While doing this the surgeon should watch if the loins either straighten themselves, or bend. Then abduction may be tried thus: the palm of the left hand is pressed against the dorsum ilii above the trochanter, while the right draws the knee outward. During this action the behavior of the iliac spine on the other side must be watched, whether it descend as the limb moves, and in the same proportion, or whether a slight outward movement can be communicated to the thigh while the pelvis remains still. Very important indications are to be gathered from the behavior of the adductors, more especially of the adductor longus, whose tendon of origin will, if the joint be still movable, make a strongly marked prominence beneath the skin. Rotation of the thigh should be tested with the aid of an assistant, who bends the knee to something approaching a right angle, takes the condyles in one hand, while with the other he uses the leg

[1] I must refer to the chapter on hip disease for descriptions of the various morbid postures which may be encountered.

as a lever, and by making the foot describe an arc to left and right, twists the thigh in one and the other direction. During this time the surgeon, with the fingers on the great trochanter and in the lower groin over the head of the bone, endeavors to detect any movement of those parts.

The Wrist is best examined by causing the patient to lift the arm at right angles to the body, to keep the elbow straight and then to throw the hand back, so that with a perfectly straight limb the part to be examined lies behind the patient. In this posture muscular movement below the elbow is difficult and feeble. Now the surgeon, taking the forearm in one hand, the carpus and metacarpus in the other, tries the mobility of the wrist, feeling at the same time for twitching of tendons. There is no obstacle here to the easy manipulation of parts; the difficulty lies in estimating the exact place where some flexibility may occur, whether, namely, at the radio-carpal or inter-carpal joint. The best way of distinguishing between these two places of mobility is to trace with the index of that hand, which holds the patient's carpus, the exact line of junction between the radius and the hand; then while this latter is being flexed and extended, observing if any hinge-like motion occurs at that place.

The Ankle presents similar difficulties with the wrist, indeed the tarsus, especially the medio-tarsal joint, becomes so flexible, when the ankle is stiff, that much care is necessary to attain to a really correct diagnosis. In the manipulation, too, a second pair of hands is often desirable. The assistant should grasp the heel in one hand, the front part of the foot in the other, and alternately bend and straighten the limb. Meanwhile the surgeon, remembering that the whole foot may readily move on the astragalus, while the ankle-joint remains at perfect rest, directs his investigation entirely to this bone. He must seek its head, and pressing upon it his forefinger, lets the others lie on the body of the talus in a curved line beneath the inner malleolus, and by this means he can estimate the movement or quiescence of that bone. Also he may find the lower anterior margin of the tibia and sink his finger as deep as moderate pressure will take it, between that edge and the trochlea of the astragalus. There is a spot just outside the long extensor of the toes, inside the third peroneal muscle, and another place between the external malleolus and the last-named tendon, where the finger comes very near to the ankle-joint, and may with considerable facility detect any up-and-down motion of the astragalus. The examination of other joints is too simple to require special description.

By these means, with or without the assistance of narcosis, the surgeon will determine whether or no there be any motion between the articulating bones. Perfect immobility and entire muscular inertia indicate bony or true anchylosis. We may add that the endeavor to flex a true anchylosis is either painless or is only painful at the place of manual pressure, whereas, in the other forms of stiff-joint, pain is felt on the side opposite to the action, *i.e.*, on the flexor side in extension, on the tensor side in flexion. Occasionally the bonds, though fibrous, may be so short and strong that the surgeon cannot detect mobility, and this more especially at the shoulder and hip-joint; but tenderness and pain coming on, in from twelve to thirty-six hours, after examination, indicate that some stretching, therefore some motion, must have occurred. This event points clearly to the falsity of the anchylosis. Confirmatory signs are a high degree of wasting of the limb without muscular rigidity; and if the joint be superficial the finger will be impressed by a sense of unity on deep palpation. The ear, too, may in such joints be usefully employed, for if a stethoscope be placed over one of the anchylosed bones, and a subcutaneous part of the other be struck, with the

interposition of some pleximeter, a much sharper and clearer note will be heard, when true anchylosis exists, than when mere fibrous bonds unite the bones.

Any mobility, however slight, more especially if muscular twitching be superadded, indicates that no true anchylosis exists. We have still to distinguish between the different kinds of partial stiffness. This, in most cases, may be achieved without difficulty, by examining the patient while conscious, and again when he is under the influence of an anæsthetic. A false anchylosis, in which the connecting fibres are both short and thick—in other words, in which the closely juxtaposed bones are bound together throughout all, or a large part, of the joint-surface, is characterized by slight mobility, perhaps a mere springiness. The motion is in no part of its course easy, but requires throughout a certain force. In some joints, more especially the knee, this form is usually accompanied by a certain amount of displacement (subluxation). Longer bonds, or bonds of less extent and thinner, allow of more and of easier motion ; but it is in no part of its extent entirely free. The flexibility of a false anchylosis is much like that of a thick piece of leather or of gutta-percha ; a certain force has to be used throughout, and this increases *gradatim* as the segment gets farther away from its accustomed position, until at last it will go no farther, save with the use of much force. To put the condition shortly, no part of the movement is free, and the check is gradual.

Joint-lameness from peri- and para-synovial causes gives a different response to the surgeon's questioning hand. Such condition has been defined as one in which the joint-cavity, however diminished, separates two cartilages of incrustation more or less healthy throughout their contact range (p. 351). But it will be remembered that this range may be very much diminished ; that the edges of the cartilage may, indeed, if the disease was severe, almost certainly have become fibrillated, perhaps ulcerated—and upon these edges the synovial membrane has more and more encroached, becoming itself thickened, and when inflammation is subsiding, shortened and retracted, These indurated folds of tissue, sometimes almost as hard as ligaments, tie the bones together in the angle maintained during the disease. If such bonds are on the flexor side the limb may be bent as much as one will, but only very slightly straightened ; if on the extensor side, the contrary condition prevails ; if on both sides, a little flexion and a little extension are both feasible. The same conditions of motion pertain if ligamentous shortening be the cause of restricted movement.[1] This mobility, however limited, is within that boundary free, nearly as free as the movement of a healthy joint, and then comes a sudden check and a stop beyond which the limb will not go. Often, if the patient be conscious, the muscles will twitch and tighten at the very moment when this term is reached ; an anæsthetic may even be necessary to determine if the impediment be or be not chiefly or entirely muscular ; but this very fact, this easy movement, within a given limit, clearly distinguishes the case from false anchylosis.

These synovial and peri-synovial ties, very frequently termed adhesion, give often, when stretched, a good deal of pain ; indeed, it not unfrequently happens, that patients endeavoring after some months of rest to use a fractured limb or a joint, which has been inflamed, will suffer a good deal, and may by the mere drag upon and disturbance of these bonds light up a very

[1] Here I am speaking only of conditions of movement ; there are certain other points mentioned immediately which clearly mark out ligamentous from peri-synovial shortening.

troublesome synovitis. Under examination the sort of pain produced by these adhesions is unmistakable. It commences with a sharp stab, at the moment when movement is checked, and if the limb be held in the same position goes on increasing, but if the former posture be restored, rapidly declines and ceases. Many patients writhe under this pain, others say it makes them feel sick; it is always very distinctly localized, and never wanders from place to place. The presence of this pain is of good augury—joints in such condition may often be cured with comparative facility. Obstacles produced by ligamentous shortening are painless or nearly so.

When muscular contracture is the cause of joint-stiffness, the diagnosis is generally easy if the patient be examined in both a conscious and unconscious condition. It will be remembered that except in cases of unusually long-continued splintage for fracture—and even in those cases rarely—contracture seldom stands alone as a cause of joint-stiffness. Also since in enarthrodial articulations, the capsular insertion of muscles forms a part of the para-synovial apparatus, the two causes of joint-stiffness are commingled—indeed united.[1]

A great deal of information is to be gathered from previous history, when this is sufficiently clear to enable us to distinguish what form of disease had affected the articulation under examination. The previous chapters have taught us to expect certain results from certain maladies; nevertheless it will be well here to place these terminations succinctly before the reader.

A short, sharp attack of sero-synovitis may leave behind considerably restricted mobility, nearly always the result of peri-synovial impediment.

If the attack of acute synovitis have been accompanied by marked pyrexia, considerable suffering, and starting-pains, a firmer and wider peri-synovial impedimenta and ligamentous shortening, even (according to severity of disease) some false anchylosis may be looked for, but an anchylosis not extending over the whole joint area.

If the attack have been still more violent and convalescence slow, more especially if abscess have formed, true anchylosis may be expected, but sometimes false only is found.

After the absorptive diseases various states are left. Exanthematous and urethral synovitis rarely give rise to worse effects than peri-synovial bonds, usually slight ones. Uterine and catamenial synovitis produce, if the attack be quickly overcome, but little restriction, but if it be persistent true anchylosis is not uncommon. Pyæmic synovitis does not often end in anchylosis; usually, indeed, when the patient recovers the joint regains its functions with great facility, but sometimes very obstinate perisynovial bonds are formed.

Long chronic maladies are generally followed by true or false anchylosis. Strumous synovitis generally leaves firm fibro-cartilaginous anchylosis, but if the neighborhood of the joint be marked by the depressed scars of old sinuses, from which bone detritus has come, true anchylosis is to be expected. Acute monarticular rheumatic synovitis, of some duration and severity, is very apt to leave true anchylosis.

Joint-stiffness after disease, commencing in the bones, except arthritis deformans, is usually due to true anchylosis; if the bones be not

[1] Certain forms of immobility, or, to say the least, of greatly restricted movement, depend on the bony changes produced by arthritis deformans—they are easily distinguishable from the forms above given by symptoms which are fully detailed in Chapter XII.

fused, excessive mobility, especially in abnormal directions, is very usually present.

True anchylosis is more rare in enarthrosis than in ginglymus, it is scarcely ever present in the temporo-maxillary articulation.

With every form of joint-stiffness, muscular contracture is usually conjoined; it is most marked in the cases that have longest been kept at rest, and in which the more severe starting-pains have occurred.

All cases of articular immobility must also be studied in reference to position; for certain joints are, fixity being postulated, most useful in a bent, others in a straight posture. Thus, a straight elbow is very valueless, as is a bent wrist; any considerable flexion of the hip and of the knee greatly detracts from the use of the limb, while the least troublesome posture for the ankle is one midway between flexion and extension. We may, then, with greater force urge upon our patients the desirability of changing the position of a bent knee, or of a straightened elbow, etc.; while, in many instances, we may advise them to be satisfied with the condition of things as they are, especially if, from constitutional or other causes, we have reason to apprehend that interference will set up fresh inflammation, or that, in spite of all our efforts, little advantage will be secured.

Leaving, for the present, true anchylosis to be dealt with hereafter, we will consider the means at our disposal for treating the other forms of joint-stiffness. These are[1]—1, sudden force; 2, gradual force; 3, division of extra-articular impediments. This last is not unfrequently to be combined with the other two devices. At the present day the use of gradual extension is almost abandoned, or is used only as an adjuvant to sudden force; because it is very slow, often painful, and also uncertain. Forcible rupture, or rapid extension of false anchylosis, or peri-synovial impediments, could only attain its present development since the invention of anæsthetics; not merely because by their means pain is avoided, but also because they eliminate both voluntary and emotional muscular contraction, thus preventing serious injuries, which otherwise are likely to result.

If the case be one of mere contracture, division of the soft parts involved will, with the aid of very slight force, be sufficient to permit the desired change of posture. The extensors rarely require division; the flexors, if more than a slight rectification be required, nearly always do so. In certain parts of the body the question may arise as to whether section of resistant soft parts should precede by a few days the rectification of posture. The answer is to be found in several considerations. If the structure to be divided is so situated, that the skin-puncture must be made at a spot which will become stretched, and if at this spot the skin is already tense, division may advantageously precede the other steps. But if it be possible to reach the tendon or fascia through some part of the skin which will not in the future procedure be stretched, it is better to perform the two operations at once; firstly, because the patient thereby escapes a second narcosis; secondly, because it is by no means always possible to be sure, until the limb is extended, that all necessary soft parts have been severed; thirdly, because section of tendons, etc., not fully stretched, is frequently difficult, sometimes impossible, and this stretching can only be done by partly per-

[1] I omit in the text certain adjuvants, such as sleeping on hot water, inunctions, of which the goose-fat or oleic acid are the best, turpentine and other stimulating embrocations, which may be used as preparatives.

forming the operation. Now, a partial rend of perisynovial bonds is more frequently followed by inflammation than a complete rupture.[1]

The division of scars, situated in a part of the skin which must become stretched in the subsequent steps, is a very important, and not always by any means an easy proceeding. These scars, the sequelæ of abscesses, are generally deep, and frequently depressed, so as to be infundibular. If they be divided right across, one cuts off the neck (if I may so call it) of the funnel, leaving a rather large hole, which may afterward tear, and is prone to suppurate. In dividing, therefore, such a scar, it is useless and dangerous to let the blade be too superficial. It should, on the other hand, sink pretty deeply in the cicatrix, and pass beneath the depths of the hollow. In case the scars are numerous, rather close together, and in a part subject to future tension, division should precede the further steps by a few days, during which the cicatrices are to be moved, hither and thither over the subcutaneous incision, to prevent renewed adhesion. Division of scar-tissue is generally so painless that it may be done without narcosis.

Forcible rupture is not a mere unconsidered application of strength; indeed, a slighter force skilfully used will often produce more and better effect than a less well-directed and more violent power. The limb should always at first be impelled in the direction contrary to that which it is desired to attain; for it is in the required path that most resistance will be found; and by taking at first the contrary course, a certain quantity, sometimes a large quantity, of the peri- or para-synovial obstacle is annihilated; by overcoming the resistance in separate detachments, we diminish the opposition to be encountered in the chief attack. The force is not to be an even and continuous strain, but a sharp, yet not too potent, jerk, or, if this do not suffice, a series of jerks, succeeding each other pretty rapidly, and carried out thus: for example, to flex a joint, the limb is to be bent till the point of resistance is reached; even a little pressure may be made on it to judge its power of obstruction; then the limb is allowed to recede (straightened) a little, to give room for an impetus, and then with a quick impulse the limb is bent. The obstacle having yielded, gentle further flexion follows until a new impediment is felt, which is to be similarly managed. Let me tell the reason of this manœuvre. All these impediments, if merely bent or stretched, give to the patient a good deal of pain, are very liable to become inflamed, and may be the source of fresh disease of the whole joint. Such bending or stretching is likely to be produced by an even, continuous force; but the sort of impulse, just described, tends to break or tear the fibrous bonds, and is far more rarely followed by inflammation or by pain. Let me also point out that the chief source of failure, as also, I believe, of danger, is inadequate operation, which partially tears and partially stretches the new tissue. But under certain circumstances, for instance, if there be that distinctly localized tenderness which indicates peri-synovial adhesion, we may obviate pain, assist our work, and more certainly cause rupture of a restraining bond, by pressing firmly with the thumb on the painful spots, while these movements are carried out; especially at the elbow, wrist, and ankle, will this adjuvant be found desirable. Such are the general princi-

[1] In the first edition of this work I advocated previous division of contractures. A further and I may say very large experience has shown me the difficulties of securing, previous to straightening the limb, section of all parts necessary, and that frequently a further division has to be made during the operation; also I have seen that careful choice in the position of the skin-puncture ensures the safety of simultaneous operation.

ples of this operation. Its adaptation to the different joints will now be considered.

The Shoulder.—An inflammation of this joint, sufficiently severe to have caused anchylosis, will also have produced contracture of the scapular group of muscles, and in all probability of the long head of the biceps. All these parts are beyond legitimate reach of the tenotome,[1] and the surgeon must trust to force only in order to re-establish the movements of the part. The patient, being subjected to the influence of chloroform, is placed upon the side opposed to that in which the disease is situated, and the operator begins the following manœuvres. Let me strongly caution the surgeon against beginning at once to force the arm away from the side in the direction of abduction, as such procedure is extremely likely to produce dislocation into the axilla. The first movement must be simple rotation; by bending the elbow at right angles with the humerus, while using the forearm as a lever, sufficient power is gained, and by grasping the upper arm as high as possible, the surgeon can direct the force. Let him not, however, rotate the humerus further outward than it normally ought to go. When this movement is pretty free, he places the arm in front of the body, and makes it cross the chest, till the elbow lies nearly over the ensiform cartilage; he rotates the humerus a little in that situation, then places the arm behind the trunk, until the elbow lies just above the sacro-iliac synchondrosis, in which situation the humerus is *not* to be rotated. Having thus loosened the adhesions to a certain degree, the operator holds the acromion and joint with one hand, in the manner previously described, and lifts the arm, as far as it will go, directly in front, *without the use of force*, and commences circumduction, endeavoring to make the elbow describe as large a circle as possible; it must be brought to at least a right angle with the body; this amount of elevation is the very least that should satisfy him; and the more he can raise the arm in this circumductory method the better. He will probably require assistance in carrying out these actions, but he should, with his own disengaged hand, hold the head of the humerus, and govern its movement; on no account should he allow the arm to be forced upward directly from the side, or danger of dislocation will be incurred. During all these manœuvres considerable extension should be made to diminish that risk as much as possible. The hand in the axilla will enable him to judge very accurately of the effects that are being produced. The most convenient posture for all these movements is the sitting one; but it is frequently not very suitable for the administration of an anæsthetic. The patient may then be treated recumbent and most advantageously on a table, covered by a blanket folded several times, so as to be sufficiently soft. When the operation is about to be commenced, he must be placed quite at the edge of the table, so that the affected shoulder projects beyond it.

The Elbow.—More or less immobility or restricted movement is a frequent result of inflammation at the elbow; also of fractures extending into or near the joint, which require long confinement in splints. Diagnosis is, on account of its situation, easy, and if the method described at p. 352 be followed, the cause of obstruction in anchylosis, or mere perisynovial bonds, may be without difficulty distinguished. The former cause of impediment is more frequent here than at the shoulder. Prognosis must depend

[1] I have never found it necessary to divide either the pectoralis or the latissimus dorsi tendons. Occasionally it has for a time appeared desirable to do this for the former muscle, but I have always found it yield to a little perseverance. It is the insertion into the fascia of the arm which more especially becomes tense.

chiefly on the result of this examination. Extensive false anchylosis of the elbow is rarely treated with a great amount of success, while mere bands of adhesion are not unfrequently eliminated with considerable ease, and the arm almost completely restored.

The position of the patient is a matter of some importance ; because it must be such as will not impede the surgeon, but rather will give him certain mechanical advantages, while he grasps the humerus, not by its middle (for mere force the most advantageous), but by the elbow itself, in such wise that the thumb rests on the head of the radius, and compels it to follow the motion of the ulna. If this precaution be neglected while the limb is straightened, and, to a less degree, whilst it is being bent, some subluxation of this bone is apt to occur. I prefer letting the patient be etherized on a table, having previously selected a stool or block of proper height, so that, when my foot is planted on it, my knee is on a level with the surface on which the patient lies. Placing one hand on that knee, I receive into it the elbow to be treated, leaving the other hand free to grasp the forearm near the wrist. The knee affords all necessary resistance or fulcrum power, thus leaving the hand the more at liberty to carry out delicate manipulations.

The sufficient repetition of jerking movements will often overcome the chief obstruction with an audible snap, after which flexion or extension may be quite free, and the prognosis of such a case is favorable. But if the impedient be produced by false anchylosis, the fibres of which, occupying a considerable extent of the joint-surface, are short, more difficulty will be found in procuring mobility. If the parts yield, not with a short, quick snap, but with a prolonged tearing sound, less favorable results will, in all probability, be obtainable ; and even those only after prolonged and persevering after-treatment. In whatever manner the impediment to flexion and extension has given way, the other movements must be freed by rotating the hand. This should not be accomplished by grasping the hand itself, as in shaking hands, since, if much power have to be employed, the wrist may be sprained ; but by seizing the carpus and lower end of the arm, so as to act directly on the base of the radius. It is rarely necessary to divide any muscles or tendons about the elbow. If the joint have been fixed in extreme flexion, however, section of the biceps tendon may be necessary to prevent, during extension, luxation forward of the radius. Such operation must be very exceptional ; in performing it, the limb must be straightened as far as it will go ; the tendon then starts out, and lies in front of the artery and nerve, when a tenotome can be passed flatwise behind it from its inner side, turned a quarter of the circle, when a very slight touch of the edge, cutting toward the skin, will sever the tendon. The triceps extensor may also sometimes be divided, to prevent separation of the olecranon epiphysis, if the arm have stiffened in a completely straight position. To effect this, the blade should be passed in about half an inch above the internal condyloid groove, in which lies the ulnar nerve. If from this puncture the knife travel under the skin across the back of the arm, and then be withdrawn while cutting down to the bone, the whole breadth of the triceps will be severed ; at the same time the long, slender nerve to the anconeus, and the little artery that courses with it, must be divided—a matter of little moment. This operation is also very rarely required.

The Wrist and Hand.—The wrist-joint is not often stiffened by true, and only a little less rarely by false, anchylosis, but peri-articular bands, adhesions of tendons in their sheaths, and other extra-articular impediments are frequent ; these may arise from joint disease or from long splintage

after fracture near or through the base of the radius. Sometimes a painful form of hand-lameness is caused by dislocation, partial or total, of an extensor tendon from its groove. Very considerable immobility, generally involving the whole hand, is produced by diffuse phlegmon with suppuration in the tendinous sheaths ; or, still worse, combined with necrotic caries of the carpal bones. Rheumatic and gouty inflammations of the joints, or of the peri-articular tissues, are frequent causes of hand-lameness. In most of these cases the various joints of the digits are also fixed in awkward positions, even though the primary malady may have involved the wrist alone. Other forms of more or less immobility are dependent on corrugations, cicatricial or otherwise, of fasciæ. Thus, it will be seen that the subject of wrist and hand-lameness, involving a great number of considerations, is too large to be treated *in extenso* here ; yet a concise account of the management in such cases, and certain definite directions as to differential diagnosis and operative manipulations, may be given.

For the present it will be better to put aside the results of severe phlegmon, with or without carpal ostitis and necrosis—a disease which so mats or glues together all the affected tissues, that each case must simply be treated on its own merits, which unfortunately are small. Gouty and rheumatic inflammations must be very cautiously dealt with, since in the former any act which involves irritation of the parts usually brings on an attack of gout, while in the latter arthritis deformans is a frequent sequela or a common companion of the disease. The stiffness of fingers and of hand, in the extended posture left after a synovitis or long splintage, may be thus overcome. It is always best to commence with the fingers ; place the thumb on the front aspect of the second phalanx, one finger on the nail, one on the first phalangeal joint, and bend with a sudden movement the patient's finger, doing the same for each one, and then bend the metacarpo-phalangeal joints till the hand is clenched. Or the surgeon may place his palm on the back of the patient's hand, letting his fingers overlie those he is about to treat ; placing the fingers of the other hand against the palm so as to keep up contact ; he then, suddenly clenching his own hand, bends that of the patient all at once and very completely. When the impediments are not very strong, and the patient's hand not too large, this is the most efficacious and the quickest method. By whatever way the bending takes place, it is very essential to ascertain that the metacarpo-phalangeal joints have been freed not only in flexion, but also in their other movements. The same remark applies to the thumb.

The wrist-joint, whether or no the fingers have participated in the stiffness, requires careful management ; it is to be remembered that it may be kept in extension by tendinous adhesions or shortening, by thickening of sheaths, and by peri-synovial bands ; and that it is more important at this than at any other joint to make out the exact place of pain. Whether or no the patient be operated on under the influence of ether, it is important to press with the thumb firmly on that spot while flexion is being enforced ; because fibrous bonds, and to them such pain is generally due, break with greater facility if their place of attachment be firmly secured, and because such pressure will prevent subluxation of a carpal bone. At this joint it is especially important to do what is necessary with a sharp jerk.

The hip-joint does not so often suffer from true anchylosis as from the other three forms of impediment, with which considerable muscular contracture is always combined. The posture is very nearly always flexion and adduction, indeed so constant is this position in hip-joint stiffness that

fixity in any other is quite a clinical curiosity.[1] Adduction connotes shortening; and flexion, if the foot be brought to the ground, involves lordosis in a degree commensurate with the bend (see p. 299); the lameness and the distortion is therefore very severe, and the spinal deformity is likely to go on increasing, so as at last to interfere with vital functions; indeed, it is difficult to imagine any more distressful lameness. Besides, when the thigh is much adducted and flexed, it is almost impossible to keep the upper part of its inner surface clean; perspiration gathers and putrefies between thigh and scrotum in the male, between thigh and labium in the female; in the latter sex micturition is embarrassed, so that this fold is often wetted and excoriated. The result in either case is an evil odor, frequent erythematous or other skin-inflammations, and occasionally painful ulcerations at the parts. It is therefore very important, more especially for a girl, to rectify this posture; this is to be done, if the anchylosis be false, by an operation, which combines free division of muscles with rupture of the anchylosis. In dealing with a case of hip-lameness, the surgeon, when the patient is fully narcotized, first bends the thigh toward the abdomen, and while still thus flexed abducts it considerably; then, using the leg as a lever, he rotates it both inward and outward. If there be a false anchylosis, the joint adhesion may be so firm and short that he can hardly effect their rupture while the patient is on a table; he will find the surest way is to place him upon a mattress or folded blanket on the floor and treat the limb after the manner of reducing a dislocation by manipulation. But, after the false anchylosis is broken down, it may be impossible to sufficiently change the postures of flexion and adduction; the difficulty is produced by contracture of certain parts which have to be divided by the knife. Flexion is due to shortening of the ilio-psoas, of the tensor vaginæ femoris, of the Y-ligament, and of the ilio-peroneal band of the fascia lata; also, in the more developed cases, to contracture of the rectus femoris.

Section of the last-named structures may be accomplished in various ways. The method I consider best is this: having fully examined the amount and mode of tension, the thigh is flexed sufficiently to relax the parts; the tenotome pierces the skin about half an inch or less below the anterior superior iliac spine, outside the line of the tensor vaginæ femoris, and takes, beneath that muscle, an oblique course upward and inward to its inner side, while the thigh is being extended; by depressing the handle, the blade of the instrument, kept close to the bone, separates the muscle from its attachment. Now the edge is to be turned more directly toward the skin, and the fascia lata—that portion which is attached to Poupart's ligament—divided to the puncture without withdrawing the weapon. If attempts to still further extend the thigh show that the outer part of the fascia impedes, the tenotome is to be very nearly withdrawn, the handle describes a half-circle round the skin-puncture, and then from this point the blade passes outward, lying a little below the crista ilii beneath the

[1] There is a peculiar condition of contracture of the thighs, which, though quite independent of joint disease, I must mention here, viz., such shortening of the adductors that the knees are kept close together and cannot be separated more than an inch or two even by considerable force. Generally a certain amount of flexion of both thighs, and even of the legs, is combined with the adduction. The condition entails very considerable lameness; it is much more common in the female than in the male, is rarely present before puberty, and at a nubile period of life may be a cause of great trouble. An instance (Case LXXXIII.) illustrating this deformity and its treatment is given in the sequel.

fascia; when the edge is turned outward it may easily be made to sever all the necessary parts of the ilio-femoral fascia.

To divide the rectus and Y-ligament, make another puncture just below the inferior spine. I prefer to do this on the inner side of the rectus tendon, to pass the blade beneath it well to the outer side, and to divide upward, keeping close to the bone. This section, if deep enough, severs both muscle and ligament. Thus, all the parts impeding extension, save the ilio-psoas, which is not accessible, have been divided; and with the exercise of a little force the thigh may now be extended, in some cases, entirely. In other instances considerable difficulty will be experienced, particularly if the flexion be chiefly due to contracture of the ilio-psoas. In such event the pelvis rises as the thigh falls, and the lumbar portion of the spine becomes greatly arched (see p. 299). It is well to let an assistant fix as far as possible the ilium, while what power may be justifiable is applied to the thigh. In my experience, however, little is immediately gained by this effort, although it renders after-treatment more efficacious than when no force has been used. Hence, after certain attempts have been made, the rest may be effected by a slower process, thus: the patient is placed on a firm bed, and his nates are raised on a hard flat pad on which a water-cushion is laid. He is to sit, or to be, as far as the trunk is concerned, in semi-recumbency, so that the thigh lies flat on the mattress, to which it must be secured by an extra sheet and heavy shot-bags. When all this is adjusted, the support, against which the trunk lies in its semi-recumbency, must be slowly depressed until he lies flat without arch of the loins. The treatment will occupy two or three weeks; during its course a bend of the loins must be taken to mean that the lowering of the upper half of the figure has been too abrupt. A mechanical couch, permitting the upper half to be raised or lowered, greatly facilitates treatment. It should be known that in certain cases, chiefly those that began in early life and have lasted for years, no mere force, either gradual or sudden, will overcome contraction of the ilio-psoas. Other means, to be mentioned in the sequel, may then stand open to the surgeon's and patient's choice, if the deformity be sufficient to warrant a more severe operation.

Adduction of the thigh is due to contracture of the adductor mass, including the pectineus and gracilis, combined with shortening of the pubic portion of the fascia lata. In severe cases it is necessary to divide all these parts; in slighter ones a certain number only need the knife. Division of the adductors is, when properly performed, a by no means severe operation, entailing hardly any bleeding. The surgeon finds the angle between the adductor longus tendon and the pubes, and here, outside that tendon and close to the bone, he pierces the skin with a tenotome. I use an instrument whose blade is four inches, the cutting part less than three-quarters of an inch long, the rest is blunt and rounded. When the instrument is beneath the skin, the thigh is drawn by an assistant outward, the adductor longus at once starts into strong relief; this is not so much divided as peeled off the bones; then the gracilis is treated in the same way. By this time the thigh can already be drawn a good deal more outward, and the surgeon can feel beneath the skin what parts become tight. If it be found desirable to divide the adductor magnus and brevis, this may best be done by placing on the tuber ischii the forefinger of the left hand, the tenotome, not withdrawn from the puncture, is glided onward close to the bone till the left index feels its approach beneath the skin. Then the operator, directing the handle outward, causes the blade to move with a swaying motion along the ramus of the ischium and pubes inward, separating the muscles from the

bone, not dividing their fleshy fibres. When this is done, and the thigh is further abducted, certain bands of the inner part of the fascia lata may be felt tense and may be easily divided. In the male the crus penis must of course be avoided. Generally such sections are quite sufficient to render abduction easy ; but sometimes the pectineus is so contractured that it also requires the knife. Division of the whole muscle is, without endangering the femoral vein, impossible ; but the inner part may be safely cut by feeling for the beat of the femoral artery, making allowance of a certain space for the vein and lymphatics, placing the left index on a spot to which without danger the knife may be passed, and making section to that place. When this has been done, the rest of the muscle always either tears or yields to the extent required. I would again emphasize the fact that bloodlessness and safety depend upon keeping the edge quite close to the bone. I have very often thus performed this operation without any blood effusion, whereas, if the parts are severed at a distance from their origin, some considerable bleeding from the sarkos of the muscle occurs, the inner part of the thigh becomes deeply ecchymosed, and the subsequent passive movements must be very considerably postponed.

After completion of the operation, and when the limb is sufficiently free, the patient should be placed in a bed broad enough to allow of his lying on the back with his thigh considerably abducted, and it is to be retained in this position by sandbags and sheets, after the manner already described. Moreover, if the malposture have involved much flexion, a firm cushion should be placed under the nates, so that the limb, resting on the bed, is fully extended. A skilful nurse will readily replace, when necessary, this cushion by a bed-pan.

The Knee-Joint may be fixed either in the position of flexion or extension, or again it may have movement within certain limits, which it is desirable to increase. The management of this last form being identical, or nearly identical, with the after-treatment of anchylosis, its consideration shall be deferred until that subject is discussed.

A knee-joint fixed in the straight position presents, in the generality of cases, but few difficulties ; yet, before undertaking any operative measures, it is well to ascertain the exact condition of parts, more especially the mobility of the patella on the femur. If this bone be fixed to the condyles, or, as more usually happens, to the outer condyle, and if, without loosening that connection, the limb be forcibly flexed, the patient will subsequently have very little power of controlling the leg ; it swings very loosely within the limits of its mobility—a serious defect, as it is under such circumstances a very unstable support. To ascertain the fixation or amount of fixation of the patella, the bone, grasped between the thumb and three first fingers, may be pushed in different directions ; frequently no up or down movement can be imparted to it, while a certain lateral mobility shows that the union is not sufficiently firm to form any serious obstacle to the contemplated procedure ; or if no demonstrable sideways movement can be obtained, one may nevertheless be able to rock the bone by placing a forefinger of each hand on its lateral edges, and pressing with one and the other alternately. In such case a little more impediment may be expected, but none that need negative flexion, combined probably with other measures.

If, however, the patella be nearly or quite free, the surgeon may proceed to operation. We suppose some very limited mobility, indicating no true anchylosis to exist. The patient is to be placed either on a table and mattress or on a sufficiently hard couch, and the surgeon should so arrange matters, that he will meet with no external obstacle or inconvenience in

carrying out his intention. I allude more especially to the fixed point, upon which he means to rest the back of the femur, while he is bending the leg. This may be the lower edge of the table, toward which the patient may be shifted when narcotized; or it may be the surgeon's own knee. I myself generally prefer this latter, as the sensation on my own limb aids the muscular sense of the arm in determining the amount of pressure and of force. When, then, the patient, lying on the edge of the couch, is fully etherized, no shifting is necessary; but the limb is abducted at the hip, and laid across the surgeon's knee, which is upheld by placing his foot on a stool or block, previously selected according to its height and firmness. Grasping now the thigh just above the condyles with one hand, the leg just above the malleoli with the other, he bends, by means of short, sharp jerks, rather than by a steady prolonged effort, the knee to a sufficient extent. In doing this, however, some caution must be used, more particularly if the original joint malady was of long duration and have left a false anchylosis, which also has been of some standing; for in such condition the ligaments, both internal and external, have undergone considerable changes, and if flexion be carried too far, they may be either rent or so loosened that a very lax joint with a highly inconvenient amount of lateral movement will result. It is better, under such circumstances, to be content with a smaller arc of motion; and, while bending the limb, to carefully ascertain, from time to time, that no mobility in abnormal directions is being produced.

If, when contemplating forced flexion of a knee, the patella be found attached to one of the femoral condyles, it behooves the surgeon to make out, with the greatest attainable accuracy, whether the union be bony or fibrous. In the latter case, the best practice is to pass, several days before the larger operation, a strong tenotome under the bone and separate it from the femur. In doing this he must bear in mind the shape of the surface, and if the attachment be wide, will find it convenient to make two skin-punctures, the one at the outer-upper, the other at the inner-lower, edge of the bone. During the next few days the knee-cap must be moved about as freely as possible over the femoral condyles, in order to make the new bonds of reattachment—and I presume such bonds always form—as long and flexible as possible. Also after flexion of the limb has been employed, and mobility given to the leg, the same manœuvre must be continued. The two operations may be simultaneous; but a better result is obtained by allowing an interval of a week between them.

In dealing with the knee fixed in flexion, we must also, before deciding to operate, study the condition of the patella, and for the same reasons as in the former case.[1] But more important still is the relationship between tibia and femur, whether, namely, this be normal, or whether some subluxation have occurred. The signs and appearances of this state have been already described (p. 118). Of course, if the knee be much bent, there is some difficulty in diagnosing with certainty the displacement, but it becomes immediately evident on even a small amount of extension.

The plan of procedure must depend more or less upon the amount of resistance which the surgeon expects; but in all cases it is well to be provided with means, more potent than the mere hands, of fixing the thigh, viz., a broad leather strap, with some pads to prevent injury to the skin. The patient should be narcotized on a table, and the surgeon should grasp

[1] If extension be attempted when the patella is fixed low down on the femur, the edge of the tibia strikes against it, further progress is stopped, and luxation takes place.

the front of the thigh just above the knee with one hand, the lower part of the leg with the other. He should always flex the limb before proceeding to straighten it, the object being to rupture, by this movement, certain bands, and thus diminish resistance in the direction desired. He then proceeds, by short, sharp jerks, to straighten the leg ; the first few inches of movement are generally easy, but soon a check is arrived at, and its reason should be studied before any further force is used. It may be that the patella (if its condition have not been previously made out and treated), fixed low down on the femur, forms a sort of buttress against the front edge of the tibia and prevents further extension. Its attachments may be divided, when feasible, in the manner above described, and further effort to straighten the leg may be used. More frequently the obstacle is due to contracture of the flexor muscles ; indeed, such condition is so usual, whenever the knee is fixed in a posture of considerable flexion, that the surgeon must be prepared to divide the hamstring tendons. This should in all cases be done close to the tibia, so that the section may be as much as possible in tendinous parts, avoiding more interference than is necessary with muscular fibre. The outer or inner, whichever is most tense, should be selected for the first operation. The skin-puncture should never be in the popliteal space, but outside it, *i.e.*, in front and outside the inner hamstring ; in front and inside the outer one. This choice is made to avoid an infelicitous accident, which has more than once been noted in the annals of surgery, namely, a rent commencing in either puncture, when badly placed, running right across the back of the knee to the other opening ; whereas, if the skin wounds be made in the part above indicated, they will be situated in portions of skin not subject to be stretched in the subsequent steps of the proceeding. To divide the inner muscles, choose a point for puncture just above and behind the femoral epicondyle, and place the forefinger of the left hand in the popliteal space outside but close to the tendons. Thrust the tenotome with its edge upward toward this finger, until it be felt approaching the surface ; then turn the edge inward, and, partly by a saw-like movement of the instrument, partly by pressing the soft parts against it with the fingers, divide these tendons and the fascia covering them.

A similar plan is to be pursued in dividing the biceps tendon ; but the position of the external popliteal nerve is to be remembered. Two fingers of the left hand, placed on the inner edge of this tendon are made to press deeply, so as to separate somewhat the nerve from the muscle, and toward one of these fingers—the one lying nearest to the fibula—the tenotome is passed, the edge turned to the tendon, which is easily divided, the fascia over it, and the ilio-peroneal band may also be severed. In further straightening the limb, a thickened fascial band often starts into relief in the middle of the popliteal space. If this be strong enough to prevent efficient extension, it also may be cut. The puncture should be made a little distance away, and the part may be incised either toward the surface or toward the depth. Of course the position of nerve and vein will be borne in mind ; also that a small incision into this thickened band will enable the rest to be torn.[1]

When thus all accessible obstacles to entire extension have been eliminated, it would appear that the limb should lie submissive in the surgeon's hands ; yet this is by no means always the case, and I cannot too strongly impress upon my readers the necessity of caution. While extending a knee-

[1] The occasional necessity for this puncture is an additional reason for dividing the hamstrings in the manner I have described in the text.

joint that has been fixed at an angle approaching ninety degrees, especially if some displacement backward of the tibia be present, any ill-considered force, any rough excess of power, is extremely likely to produce posterior subluxation. The surgeon then must not be content merely to verify the fact that the limb is under his efforts becoming straighter; he must see that this is produced by the proper changes of position, and that the tibia is gliding, not backward, but forward on the condyles. Moreover, if the slightest tendency to backward displacement appear—if the parts just beneath the patella are seen or felt to become more hollow instead of more prominent—he must at once stop all attempts at continued extension. It may be that by downward traction on the foot he may gain a little more rectitude without further displacement; also if the limb be fixed a week or ten days in the furthest extension compatible with safety a future effort may be of considerable avail; but at the present moment all efforts at angular straightening must cease. It is somewhat difficult to distinctly verify the structure which produces this tendency to posterior luxation, nevertheless I think I am right in saying that it is the anterior crucial ligament [1] which is relaxed during flexion of the limb. If this flexion be prolonged it retracts, then thickens and hardens to an abnormal brevity. When in such condition the limb is straightened it does not allow the tuberosity of the tibia to glide forward on the condyles, but retains it in the place it occupied during flexion. But a straight tibia, the anterior edge of whose tuberosity rests in extension on the same part it lay on in flexion, is from an inch to an inch and a half too far back, *i.e.*, is partially dislocated.

The method of fixing the joint so as to lose nothing of the advantages gained, will depend partly on the surgeon's predilections; but he must in all cases be guided by two circumstances, viz., the amount of force that has been used, and the amount of rectitude attained. If the knee has been straightened as much as is desirable by the expenditure of little force, the limb may advantageously be put in plaster-of-Paris. If this end have only been gained by considerable exertion, a certain amount of inflammation may be expected; wherefore, a back splint, for instance an Amesbury, leaving the joint free for the application of ice, is preferable. Again, if an insufficient extension have been gained, an Amesbury splint will, by its screw-force, enable us, within the next few days, to gain a little more. When the stiffness has depended upon mere para-synovial impediment, and the object therefore is to give freer movement, an Amesbury splint is the best appliance; it permits us to put the limb sometimes more flexed, sometimes more extended, and thus to prevent the regeneration of thickened bands.

The Ankle is very often stiffened by tendinous displacement or adhesion, but also by causes nearer to or in the joint. The first two are the sequelæ of sprains or of fractures near the malleoli, and are, with the same form of injury at the wrist, the chief cases that make the reputation of bone-setters. Such a case is that of

G. R., a gentleman aged nineteen, who sprained his ankle in a foot-race. He told me that the pain came on, and that the sprain seemed to occur not when the weight was on the foot, but when it was lifted. He fell simply because he dared not put the foot to the ground, and tried to save himself by hopping on the sound one, but his impetus was too great. He came at

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[1] This ligament is the chief opponent of excessive extension, and of forward displacement of the tibia. When shortened, therefore, as described in the text, thereby adapted to a flexed posture only, it must, when the flexion is straightened out, force the tibial tuberosities backward.

once to me, February 6, 1864. The ankle was not swollen, and I failed to discover anything abnormal in the position or condition of the parts. Two days afterward he came again. My treatment (the opera-dancer's cure) had greatly diminished the pain, so that he felt none while at rest; but as soon as he tried to put weight on the foot, a sharp pain rendered the limb useless. I now examined him more carefully, and found a rounded line running obliquely down the outer surface of the fibula. This could be moved by the finger back and forth upon the bone, and was evidently the peroneus longus tendon. I placed my patient on the couch, flexed the foot to the utmost, rotating it out, kept it a few seconds in this position, and then suddenly extended and turned the limb inward. A sharp and loud snap took place, the rounded line on the fibula disappeared, and he now at once could bear his whole weight on the foot without pain. Strapping plaster was tightly applied, to prevent displacement, caution in moving about enjoined. The tendon—and I have frequently seen the young gentleman since—has never slipped out again.[1]

In another case the posterior tibial became dislocated, and its replacement was far more difficult.

After sprains of some severity inflammation of the tendinous sheaths is very apt to leave adhesions between their inner surface and the tendon itself. Here, too, the bone-setter has succeeded frequently in restoring painless motion, which a more cautious—perhaps I should say timid—treatment has failed to confer, for if once these adhesions be broken or sufficiently stretched, they give no further trouble. Under much the same category come the slighter forms of the para-synovial impediment, cases that are particularly amenable to an energetic and well-directed treatment.

On the other hand, severe para-synovial impediments and false anchylosis, unless of very small extent, are at the ankle-joint very refractory by reason of the anatomical conditions. No other large articulation is formed at the distal part by a bone so short as the astragalus, so devoid of muscular attachment and with other joints so closely packed in its neighborhood. Hence this bone, when fixed with some pertinacity to the tibia-fibular surfaces, offers no place of vantage for a grip or for leverage. We may seize the front of the foot in one hand, the heel in the other; but the force exerted will primarily affect the medio-tarsal, and the calcaneo-scaphoid joint. If these be free, they may still further be loosened; but the ankle will only be secondarily influenced, if at all. We can, therefore, hardly bring to bear upon the ankle-joint sufficient power to solve any firm impediments in that articulation, unless we call in the aid of mechanism to support and uphold the tarsal joints. A piece of poro-plastic felt is to be cut and moulded to the sole of the foot and allowed to dry. This is afterward put *in situ*, and the foot from the root of the toes to the point of the heel, avoiding the malleoli and the part just in front and behind them, are enveloped in a plaster-of-Paris bandage, and sufficiently covered with plaster to be on the next day very strong. It is well, while the plaster is half set, to see that its edge behind and in front leaves room for the hinge-movement of the joint, and to cut away, while still soft, all undue projection. On the next day, the plaster being firm and the poro-plastic felt quite stiff, the foot is, as it were, consolidated for the time into a single mass, and power may be exerted on the ankle-joint without endangering or wasting one's efforts on the other articulations of the foot.

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[1] This amount of good fortune is rare; a dislocated tendon is generally subject to frequent displacements.

The more usual posture in which the ankle-joint is stiffened, is with the foot at right angles to the leg; if the obstacle to movement be in such case considerable, the surgeon will remember that in a short time the tarsal joints acquire a flexibility, which forms an excellent substitute for ankle-movement, as is evidenced, among other events, by the excellent performance of the limb, when, after excision, the astragalus and the tibia are immovably united. Under such circumstances, the employment of any considerable violence can hardly be justifiable; section of tendons or of other structures is perfectly unnecessary.

Occasionally, when the ankle is stiffened, the foot is considerably flexed: in such case the amount of impediment at the ankle itself must be judged partly by the resistance to further flexion, partly by the tension of the tendo Achillis, when extension is tried. If the impediment to extension be chiefly tendinous, section of that structure and a slight amount of force will put the foot in good position. If the impediment be very much in the articulation also, the plaster-of-Paris appliance may be adopted the day before; then the tendon may be divided and the foot in its firm case can be extended. More persistent effort than in the former position may be employed to loosen the false anchylosis, since the posture is a decided detriment. No other than the tendo Achillis should be cut, for no tendon is inserted into the astragalus, and none other than the above-named behind the ankle-joint.[1]

The after-treatment of all these cases is, firstly, to obviate inflammation or to combat such as may supervene, unless any great resistance have been so forcibly overcome that some inflammatory action may be confidently expected; rest for the first twenty-four or forty-eight hours is all that will be needed, but this rest should be complete; some immobilizing appliance must be used, and on the choice of these a few words will be said hereafter. In some cases, especially if the angle have been much changed so that some of the soft parts are considerably stretched, an opiate will be desirable, and this is of course best given hypodermically, and for choice in the operated limb. If inflammatory symptoms appear, cold is the best remedy; it should be applied by an ice-bag, and if the posture in which the limb has been put at rest causes much tension of parts, this may be slightly changed; but it must be remembered that a certain advantage is lost by such concession. The inflammation, unless unjustifiable violence have been used, subsides in a few hours.

The choice of means, wherewith to secure rest, and at the same time good position, must depend upon the expectation that the operative measures may have been severe enough to produce inflammation, and also upon the result we may hope to attain. If inflammation be expected, some appliance, which leaves the joint free for applications, must be chosen. Thus, an Amesbury splint for the knee, a rectangular splint for the elbow, and so on. If the limb have not been placed quite as far as could be desired in the desiderated posture, the Amesbury for the knee and ankle will permit of further, more gradual rectification. For the elbow may be used a splint formed of two metal gutters for the inside of the arm and forearm respectively, jointed together at the angle and provided with a screw and winged nut, enabling the surgeon on each visit to move the

[1] Deformity of the foot proper belongs to another domain of surgery; here we are dealing merely with conditions of the ankle-joint. In another work reasons against division of tendons about the foot are sufficiently discussed (see case on Clubfoot without Cutting Tendons).

limb, and then, by giving a turn of the nut with finger and thumb, fixing it in any desired posture. Such splints may also be used, if a movable articulation is the aim in view. Cases of para-synovial impediment usually permit the attainment of a movable joint; so also with the slighter forms of false anchylosis, while in the more severe cases of this latter condition we usually must be satisfied with mere rectification of posture. This is especially the case with the knee, because, after the great changes of structure which a considerable false anchylosis connotes, free motion at the joint is too frequently accompanied by a looseness of parts, which renders the limb an insufficient support. When, under such circumstances, a mere rectification is the object to be attained, and if we expect no or only slight inflammation, the best appliance is some immovable apparatus: plaster-of-Paris, which sets so quickly that the limb is fixed before the patient recovers consciousness, is the most convenient for all joints except the hip and shoulder. Also convenient is the poro-plastic felt, which enables us to have a part of the joint in view, and move it from its case occasionally. Its disadvantage is, that we can never be quite sure, before operating, of the position to which we shall attain; this is overcome by having two or three such splints cut at differing angles, fitting both upper and lower segments in various postures.

If the object have been to regain mobility, a course of passive movement must be begun (absence of inflammation being supposed) not sooner than three days and not later than a week after operation. If the patient be courageous and motion of the joint not very painful, this may be carried on without an anæsthetic; but sometimes it is necessary to repeat the narcosis; only let the surgeon remember that mere rupture of bonds is not now his object; he must move the limb in its various directions a good deal—the more the better, if he use his judgment to avoid what may induce inflammation. The fingers and the elbow have most frequently to be thus treated twice. A good and experienced rubber, having been well instructed by the surgeon as to what he requires, will effect more than the patient himself: nevertheless, at certain joints, as the knee, elbow, and wrist, certain assistance by means of weights is very advantageous.

To regain much movement in a joint that has been considerably stiffened demands from the patient perseverance and some courage; if he have not or will not exercise these qualities, the greatest skill on earth will avail but little.

True anchylosis or osseous union between the bones of a joint[1] is no unfrequent event; indeed it has been shown in preceding pages to be occasionally the best and natural cure of certain severe diseases. The surgeon's duty, under such circumstances, was explained to be so to place and maintain the joint, that when the process is complete, the limb shall be left in the best possible position for future use, such position being not merely different for different joints, but in a less degree for the same joint of various persons, according to their occupation. Thus, when the result of an articular disease must be anchylosis, care and attention on the part of the surgeon, docility and patience on that of the sufferer, will render subse-

[1] Some writers use the words synostosis and anchylosis as synonyms; etymologically there may, perhaps, be no objection to this employment of the terms; but it is well to have a distinctive meaning for words, hence I write synostosis only when speaking of bony union after removal by operation of the joint-surfaces, true or bony anchylosis only denoting osseous union as a process and outcome of disease.

quent interference with the limb unnecessary; but nevertheless, from neglect to consult a surgeon, from severity of disease, from lack of courage on the one side or of patience on the other, we frequently have to do with inconveniently anchylosed limbs, and patients are very desirous of having this trouble removed. The surgeon is bound to take into consideration such wishes; but at the same time to explain the nature of the operation, as also what can and what cannot be gained.

Many methods have been devised for the attainment of the object in question. Forcible fracture, by powerful machinery[1] or simply by the manual force of surgeon and a staff of assistants,[2] has been much vaunted, chiefly by Continental surgeons, but as it is probable that all such procedures have been superseded by less violent and more certain methods, references to these proposals and cases need not be given.

The procedures of the present day and of a wide future are two, namely, the removal of a wedge from or simple section of the bone, either on the site of the anchylosed joint or in the shaft above or below. To an American surgeon, Dr. Rhæa Barton, belongs the honor of first practising osteotomy with removal of a wedge. His patient had anchylosis of the hip; in 1826 that surgeon "sawed through the great trochanter and the neck in a transverse direction." Passive motion was used after three weeks, and for a time the false joint remained mobile, but gradually became quite fixed. I find no record of any repetition of this bold procedure until 1862, when Dr. Lewis Sayre removed, for true anchylosis of the hip, "a roof-shaped" segment of bone from the femur above the small trochanter. Some exfoliation occurred, but in seven months the man walked very well, and reported himself a year afterward as moving about with ease. It may be doubtful whether a movable joint was obtained; if not, the flexibility of the sacro-iliac articulation formed an excellent substitute for hip-movement; the result was eminently satisfactory. In November of the same year Dr. Sayre repeated this operation on the person of a young lady. At first her progress seemed satisfactory; but abscesses afterward formed, exfoliations took place, and the patient succumbed six months after the operation with lung complications and other troubles.[3]

In 1869 Mr. William Adams sawed through the neck of an anchylosed femur. He calls this operation subcutaneous section of the femoral neck. His case was successful. In 1876 he published[4] the results of twenty cases at the hands of different surgeons; of these three died. Of the seventeen given as successful, a goodly proportion suffered from suppuration; some of them from considerable suppuration.

In 1872 Mr. Gant divided the femur some distance below the small trochanter with a narrow saw. The case was successful, and has been repeated.[5]

In October, 1878, I divided the femur above the small trochanter with a chain-saw. The boy, aged fourteen, had complete anchylosis of the hip at an angle rather less than ninety degrees. The boy had no pyrexia; the wound healed rapidly and without suppuration; the success was remark-

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[1] Louvrier, of Paris.

[2] Max Langenbeck, of Hanover, Ueber gewaltsame Strechung, etc., and others.

[3] Some controversy arose between Dr. Sayre and Dr. Bauer as to whether or no the abscesses of the lungs were pyæmic or tubercular. I would not attempt to decide this point. Examination of the part operated on showed the ends of the bone encrusted with cartilage and bound together by two thin fibrous bonds which Dr. Sayre compares to the round ligament of the hip. (See Sayre's Orthopædic Surgery, p. 484.)

[4] Med.-Chir. Trans., vol. lx., p. 1.

[5] Gant's Surgery, vol. ii., p. 45.

able. (See Case LXXXV.) I had intended to perform this same operation on another patient, in September of the same year, but, being obliged to leave town, asked my friend Mr. Cantlie to do it for me. Some difficulty in getting the saw round the bone induced that surgeon to use the chisel; the boy progressed well, had some suppuration, but made a good recovery. The operation eliminates a very bad form of lameness and of deformity.

We now go to true anchylosis of the knee, and again begin with Dr. Rhæa Barton, who in 1835 sawed a wedge of bone from the front of the femur a little above the condyles, taking care not to divide the posterior surface, close to which lies the popliteal artery. In order to reach the bone a triangular flap, consisting of all the soft parts, was made by making an incision, commencing on the outer side, across the front to the inner side of the limb. From the same point, on the outer side, another incision was made at an angle to the first, so as to leave in front two and a half inches clear space. This large and thick mass was then thrown to the inner side, resection of the wedge effected, the remaining portion of bone broken, and the limb put up with the leg straight to the femur. This operation has been performed fourteen times with two deaths.[1]

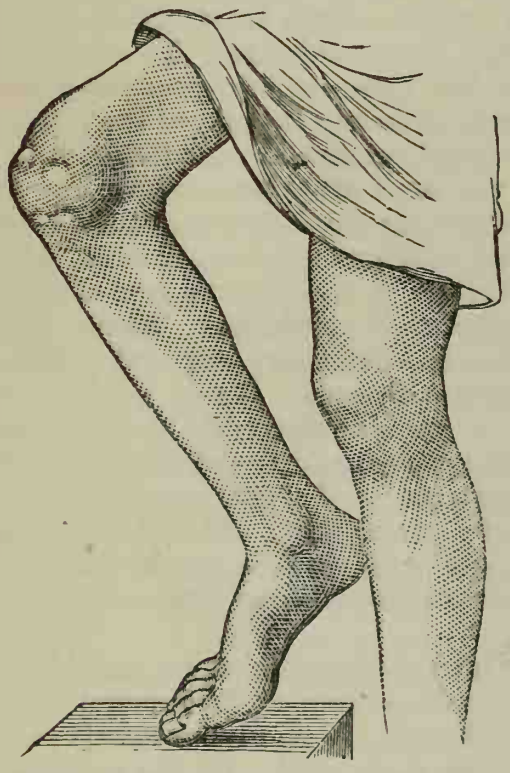

Fig. 66.—C. G. Synostosis at an angle of 80°.

In 1853 a modification of this operation was introduced first, I believe, by Sir William Fergusson. He applied, namely, excision of the knee-joint, hitherto performed only for active disease, to this form of lameness, removing from the substance of the anchylosed joint a sufficiently large wedge to permit the leg to be placed straight while the sawn surfaces are in complete contact.

In 1861 Dr. Gross, of Philadelphia, perforated the anchylosed parts with a peculiarly formed instrument, and moving it about broke down the newly formed bone-tissue until he could straighten the limb, probably fracturing the remaining union. Of these two American operations, neither have found imitators in England. Excision of a wedge from the knee has often been performed by myself and others. It is a severe operation, the death-rate not small, and the result hardly sufficiently certain. I do not think that any modification of this treatment was made, at all events not in England, until I substituted simple section of the femur just above the condyles.

The first case in which I performed that operation was that of

Case LXXIX.—Catherine G., aged fourteen, was admitted December 5, 1876, into Charing Cross Hospital. It was rather a case of incomplete synos-

[1] For further details see Gross's Surgery, vol. i., p. 1093. I cannot agree with the eminent Philadelphian professor that "the success would thus seem to be eminently flattering." 14.3 per cent. is far too high a death-rate for an operation of convenience merely.

tosis after excision, which was performed by Dr. Samuel Wood, of Shrewsbury. The parents took the girl away before the case was complete and an unfortunate angle was the result. I think there was some slight movement between the bones, but it was evident that only evil could result from forcibly straightening them. There was some loss of length, probably as much the result of disease as of the excision.

	Left.	Right.
Femur.....	16	$13\frac{3}{4}$
Tibia.....	$14\frac{1}{2}$	$13\frac{3}{4}$

On December 21st I divided the femur above the condyles, and dividing the semitendinous, brought the limb nearly straight; it was put into a plaster-of-Paris bandage. I had questioned in my mind whether to divide also the leg-bones, but knowing that the leg was already short, I deemed that the little additional length to be gained would be purchased somewhat dearly by an extra operation.

The wound healed rapidly, and the girl was discharged on January 30th, with the result as here seen; she walked well with a high shoe. She has been under my observation ever since, and, except want of length in the limb, there is nothing to be desired.

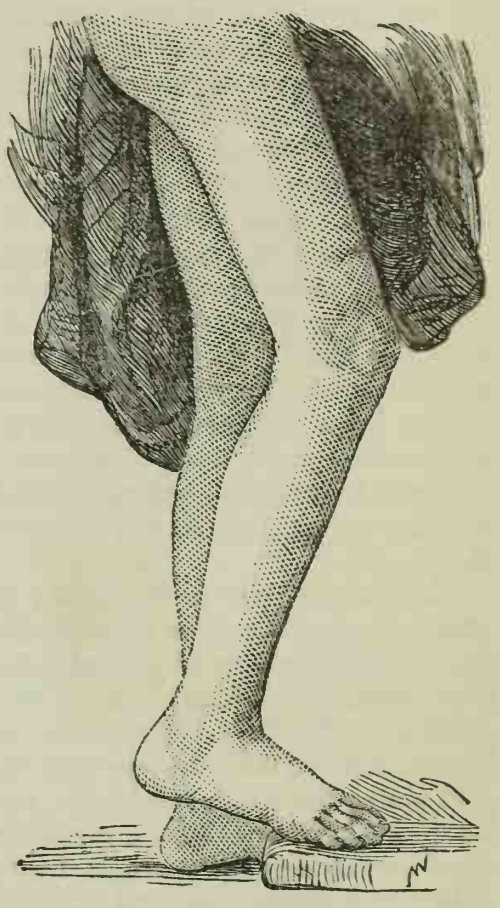

Fig. 67.—C. G. After osteotomy.

The principles founded on this and some other cases, upon which I found my preference for simple section of the bone in either place above mentioned, are these: the wound of soft parts is very small, and heals very rapidly; the breach of continuity in the bone often does not extend through the periosteum, and since the fracture is immobilized at the moment of occurrence, union of the parts is extremely rapid. The patient suffers slight pain only for an hour or two after the operation, and even this may be eliminated by anodynes or opiates. There is no suppuration and no pyrexia. In none of my cases has the thermometer risen to over a hundred, and even to this temperature only on the third day, when constipation occurred, and immediately falling on the action of an aperient. Naturally, since the fragments do not lie in a straight line, but at an angle with each other, there must be between the severed ends an angular or wedge-shaped gap, representing the complementary angle of flexion at the joint. This gap must be filled up with new bone. Nature effects this with the greatest precision. An operator, however skilful, can hardly with equal exactness remove a wedge of precisely the right size. I have never, in the great number of my operations, found her fail to make the junction entirely reliable in strength. There must also be on the extensor face of the divided bone, supposing that the limb have been anchylosed in flexion, an entering angle

equal to that at which the limb was bent. How beautifully does Nature order the subsequent shaping of the part! The limb, bent into a more or less sharp corner at the place of section, gradually, after union is complete, loses that angular aspect, and becomes either straight, or follows simply a gradual sweep, the curve of which, extending over some little length of the bone, equals the angle at first produced. The reason of the change is this—the muscles, and other soft parts which lie over the concavity of the bend, exercise no pressure on the bone at that part, while those that are placed on the convexity exert increased pressure. Hence, when the bones are knit, and the callus is to be modelled, absorption only occurs at the salient, while that on the re-entering angle, where no pressure falls, is left *in situ*, and becomes perfectly constituted bone-tissue. Six months after this procedure, only a very gradual curvature, which, in a long bone like the femur, is only detectable by a practised hand, can be verified (Fig. 67).

Simple section of the bone above, or in some cases both above and below the joint, is now, or must shortly be, the method, *par excellence*, of rectifying a true angular anchylosis of the knee. It is an operation which I first in England (Volkmann had preceded me in Germany) applied to this condition; this was in 1876. The result was perfect (Case LXXIX).

In January, 1877, I performed my second, indeed, the second operation in London. (See Case LXXXVII.) The flexion in this latter case was considerable, and, as many sinuses had left scars around the knee, which looked as though much bone had been exfoliated, I feared to divide the bone very close to the joint, and also to intrust a part which had been so diseased with the task of filling up a very wide interval; therefore I divided the complementary angle equally between femur and tibia, and cut through the former bone higher than in the previous case. I have since performed this operation a great many times, *i.e.*, sometimes the single, sometimes the double one, for true anchylosis. In my hands it has presented no single case of failure, nor, indeed, any symptoms causing me to doubt for a moment of the result.

Afterward, viz., in the latter part of 1878, and again in October, 1879, cases of very firm false anchylosis came under my care. Attempts at forcible rupture were only partially successful; that is to say, posterior dislocation became imminent before the limb had been placed in the most useful position. Further efforts were abandoned, and a retentive apparatus applied. After a week in one case, ten days in the other, the femur was divided just above the joint, the limbs placed in a straight, or nearly straight, position, and enveloped in a plaster-of-Paris bandage. Here the results were most gratifying, the patient having the leg rectilinear with the thigh, and enjoying a certain amount of motion at the knee, which rendered the gait more easy and elegant.

In March, 1878, I divided, just above the condyles, the humerus of a gentleman whose elbow was anchylosed in a position so straight as to render the arm very useless (Case LXXXVI.).

These—viz, elbow, hip, and knee—are the only joints at which osteotomy for true anchylosis will be used; at all events as a usual procedure, although it may be that, occasionally, a surgical curiosity of extreme malposture at the shoulder may call for operation.

The operation of osteotomy is in itself simple; but the operator should make himself acquainted with the form of the bones in section at various parts of the shaft; he should also—for other deformities than joint-stiffness may require, by this means, rectification—be familiar with the changes of shape produced by rickets. The chisel is far preferable to the saw, since

it leaves no débris, no sawdust. I should always employ it for all sections, save that of the femur, above the small trochanter, perhaps in some cases, not in all, for section at the neck of that bone. It is always advisable to perform the operation antiseptically. A small skin-wound, making the operation nearly subcutaneous, may secure safety in a large number, perhaps the majority, of instances; but when this smallness of wound is combined with antiseptic precautions, the operation seems absolutely without risk. I have performed osteotomy in a great many cases, public and private, dividing a large number of bones. In no one case have I had any bad, not even a minatory, symptom.

The mode of dividing the humerus just above the condyles, differs from the modes employed in other parts, since two skin-wounds are advisable, and a narrower chisel may advantageously be used. This part of the bone may be described as consisting of two columns, which diverge from a spot above the olecranon fossa, and end below in each condyle. It appeared to me desirable to divide each of these columns, but to leave the part between them, which is very thin, untouched. The first skin-wound was made above the outer condyle transversely, so as to have the condylosed ridge a little in front of its centre; it lay, therefore, rather behind the bone. The chisel, about a quarter of an inch broad, was driven inward until it reached the outer border of the olecranon fossa. The inner wound was made in front of the condyloid ridge, and the chisel was directed backward and outward toward the olecranon. The rest was fractured with the greatest ease. The one wound healed in six, the other in eight days. Union was perfect at the end of three weeks, and an excellent posture secured. For safety sake the arm was kept in a dextrine bandage for a fortnight more, but otherwise freely used.

Mr. Adams' operation for dividing the neck of the thigh-bone is to thrust a large tenotome from behind and inside the great trochanter above the neck forward, as far as may be considered desirable and safe. Into this wound a similarly shaped saw is passed, and the bone is severed far enough down to render fracture easy. Although in 1877 twenty cases of this operation are reported, the particular condition requiring and permitting its performance must be rare. The usual malady termed morbus coxæ, if it proceed far enough to cause anchylosis, nearly always produces also absorption of the neck. The next most usual hip-malady is arthritis deformans. Puerperal or exanthematous affections, if severe, usually end in dislocation. There remain, then, only severe traumatic and rheumatic coxitis, which could produce the condition in which section of the cervix femoris could be or should be performed.

Mr. Gant's operation must (I have never been so fortunate as to see the one case, with whose results he is acquainted) produce considerable deformity and shortening, in exact proportion to the distance between the middle of the neck (axis of movement) and the place of section, probably never less than three inches abbreviation, and in front a piece of bone three inches long, projecting bowsprit-like from the pelvis.

In such cases—as from absorption, or other alteration, about the neck of the femur—Adams' operation is inadmissible; that is to say, in nearly all cases of anchylosis from morbus coxæ (technically so called), and in most cases from other diseases, division of the femur above the lesser trochanter is the best; but I cannot agree with Dr. Sayre as to the advisability of sawing out a "roof-shaped" piece of bone. I believe osseous union will take place just as readily after removal of such a piece as after a simple section. I know by experience that a joint, with cartilages, ligaments, etc., such as he

wishes to obtain, cannot be formed; and I question if such a form of false joint, could it be produced, would be reliable for support. A fibrous union, *i.e.*, the ordinary form of non-union in fractures, might be more frequently procured, but would also prove, I venture to predict, disadvantageous, because too yielding. A young patient soon acquires great flexibility of the ilio-sacral joint, as well as in the lower lumbar articulations, which very much compensate for want of mobility at the hip, *if the limb be in good posture and not short.*

The operation is hardly easy, and requires, for passing a chain-saw round the bone, a special instrument, namely, a tube like a large Bellocq's sound, carrying a stout watch-spring, with lancet-shaped tip, armed by a stout silk thread. The operator commences by making an incision two inches long, from a little below the tip of the great trochanter, vertically down the outside of the bone; then, across the middle of this, another, rather longer than the breadth of the femur. Both these must go through the periosteum, quite down to the bone. The knife is then laid aside, and the surgeon with an elevator peels the periosteum and soft parts entirely away from the outside, front, back, and inside, of the femur; then, passing his left forefinger behind the bone, he will feel the small trochanter and tendon of the ilio-psoas inserting itself therein; above this is a space, bounded above by the curved cervix femoris. Keeping his finger *in situ*, he now takes the sound and insinuates it in front of the bone till he feels the end of the tube come against, or in close proximity to his finger; he then protrudes the spring, the end of which presents in the back part of the wound, seizes it and draws it, together with its armature, out of the wound, and tube, which latter is then removed. The chain-saw is attached to the silk, drawn through and the bone divided entirely, being kept by an assistant in gentle abduction to prevent the instrument becoming jammed. The thigh now lies loose in all directions, except, perhaps, that of extension and of abduction; yet the limb must not be subjected to strong tension, lest that tubular encasing of periosteum, which has been carefully peeled away and left intact, should be ruptured. The integrity of this membrane ensures rapid union; hence division of soft parts may, in some cases, be necessary, after the manner described at pp. 362, 363.

The patient, conveyed to bed, should be placed with the abducted thigh covered by a sheet secured with sand-bags, and to the foot extension to the amount of from three to six pounds is to be employed. Very little pain follows this operation; the chief discomfort appears to be produced by dragging on the ilio-psoas. After from four to six days an additional amount of extension may be obtained by placing the buttocks on a pillow (p. 364); in a fortnight chloroform may, if necessary, again be given, and some additional forcible extension used, the periosteum being now strong enough to bear it. I should, under nearly all circumstances, prefer this procedure to myotomy at the time of operation.

Division of the femur above the condyles, as a remedy for true anchylosis of the knee-joint, is likewise a safe operation, provided the surgeon has a sufficient knowledge of the shape and dimensions of this part in section. In his choice of the level at which he will make his incision, he will remember that the higher the division the greater will be the resulting forward projection of the knee; for if he intend to divide the femur only, the angle between the fragments must be equal to that at which the knee is flexed, and this wherever the section is situated; therefore, if he make his lower fragment four inches long there will be just double as much projection as when he makes this portion only two inches in length. Yet evidence of old

but very extensive disease may cause us to avoid osseous division very low down on the bone. The same reasoning holds good if he intend to divide the leg-bones also, only we have to do with a fraction of the angle of anchylosis instead of with the whole. To determine the expediency of trusting entirely to division of the femur, or of adding section of the tibia and fibula also, depend upon the amount of bend at the knee. If the anchylosis be at a right angle, for instance, the fragments, to render the limb straight, must lie at the same angle, and the cut surfaces are also in the same relative position. Thus a rather large gap will require to be filled up, whereas by a double operation we may divide this space equally between parts above and below the stiffened joint, and in so far more surely obtain security of union.

To divide the femur, choose (unless bygone severe disease forbid) a spot above the outer condyle and epiphysis, just where a ridge separates the surface for the patella from the non-articular portion; pass here a scalpel with the edge looking backward down to this ridge, and cut, keeping the blade on the bone backward for about half an inch, according to the breadth of the chisel. Let the instrument remain *in situ*, while on its flat the chisel glides into the same periosteal wound. Tap on the chisel-handle, at first gently, until the weapon is felt to bite, when the power may be a little increased, and now drive the instrument in different directions, loosening it now and again, avoiding going in any direction through the bone, but leaving a thin outer shell untouched.[1] This must be more particularly observed behind where the popliteal artery might be endangered by an incautious blow in that direction. If all this be satisfactorily accomplished a slight jerk upward on the leg breaks the remaining shell. The limb is now to be dressed antiseptically, placed in the intended position, and enveloped in a plaster-of-Paris bandage.

If it have been thought better to apportion the rectification between the thigh and leg-bones, the next operation may take place in a fortnight or three weeks after the former, according to the age of the patient. I prefer dividing both bones below the knee, rather than one only, and trusting entirely to force for fracturing the other,[2] as being more certain and no addition to the troubles of the patient. Just below its head the fibula becomes narrowed into a thin neck; over this place the knife may easily be sunk to the bone, a chisel introduced, one or two taps on which will suffice to render fracture with the thumb easy. To sever the tibia a spot should be chosen on the inner posterior edge of the bone on a level with the lower part of the tubercle. The chisel from this point is directed outward and forward, running parallel and close to the subcutaneous surface toward the tubercle; it then may be directed in a line rather farther back, and again, if the subject be full-grown, in a course still more backward. These three cuts, none of them breaking the surface, will suffice to permit facile rupture of the remainder, while an assistant holds the knee and parts below the late femoral fracture very securely. Now entire rectification may take place with or without division of the hamstrings; plaster-of-Paris bandages applied, and allowed to remain for about three weeks, after which the patient is released, and may begin, with proper precautions, to get about.

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[1] The chisel should not be too sharp so as easily to cut soft parts, yet not so blunt as to require heavy mallet-blows.

[2] The late Mr. Maunder told me that in an operation for deformity he, after section of the tibia, tried to break the fibula, but failed, producing a subluxation and very severe bruising, from which the patient suffered greatly.

Case LXXX.—Mrs. F., aged thirty-four, consulted me April 14, 1876. During the Christmas week of the previous year she had fallen on the stairs and saved herself by the hand. It swelled up immediately and was put upon splints; it remained on splints for nearly three months; although one or two attempts had been made to leave them off, pain caused their re-application.

The hand and fingers were stiff, having that peculiar, dumb, helpless look, so constantly seen when the extremity has long been immobile; the skin was rough and leathery; any movement in flexion, whether of fingers or wrist, was painful. I succeeded, however, in bending the fingers at once, and after a few days, during which inunctions with lard and oleic acid, and as much moving as she could be got to employ, were inculcated, they were certainly freer. The wrist was very inflexible, and when it was bent beyond a very slight degree, she complained very much of a pain along a line from the radius to the second and third metatarsal bones; either end of this line seemed more particularly tender. She would not take ether. I having explained to her husband that I would some time take her unawares and bend the joint, on May 2d examined the wrist, and, giving it circumduction within the limits of pain, talking of a subject that interested her, and keeping my thumbs on the points of pain, suddenly and very sharply bent the joint. There was a sharp snap and she cried out; but I was rather surprised at the small amount of pain, which only lasted a very short time; the wrist was flexible. I put it on a poro-plastic splint, and ordered cold applications.

May 3d.—She slept well; had a little pain; put her through some passive movement and replaced the splint.

May 20th.—Had no bad symptom. Hand nearly free in all movements; the rest only a matter of a short time.

Case LXXXI.—James E., aged fifteen, has had synovitis of the elbow, with abscess, ending in false anchylosis, at an angle of 135° (right angle and a half); arm very useless. Came under my care into hospital, December, 1871. I had made for him a splint, of arm and forearm portion hinged together, the hinge fixable by a screw.

December 30th.—Broke down a very firm anchylosis, which yielded with rending sound, no sections necessary; put the arm in a splint at a right angle.

January 10, 1872.—Ice was freely used to overcome some rather sharp inflammation, which had, at above date, almost disappeared. Placed the splint (with arm on it) at a rather acute angle.

January 21st.—The arm removed from splint and examined; there was no inflammation, but it was very stiff, and attempts to alter the position very painful. Mr. Braine was kind enough to administer gas. I rapidly bent and straightened the arm twice, and rotated hand; the resistance was trivial.

January 24th.—Some slight inflammatory symptoms were kept down by ice. Orders were given to put the arm in a slightly different position morning and evening, going for three or four days in the straightening, and then for a series of days in the bending direction. The hand (not included in the splintage) was moved daily.

May.—The case was a very long one, but its results very satisfactory. The boy could very nearly straighten the arm, and could get his hand to his mouth while the head was erect. He required very sedulous watching, not having courage or industry to manage his own limb. For ten days in March, during which he was an out-patient, his arm visibly deteriorated, and he was readmitted.

Case LXXXII.—Miss F. L., aged fourteen, was brought to me by her mother, suffering from anchylosis of the hip, February 24, 1866. The deformity was in flexion and adduction ; her lameness extreme ; yet there was a certain mobility at the joint. The upper and inner part of the thigh was red, and quite at top excoriated ; this part always was wetted in micturition, and at her age other matters began to trouble her. It was impossible to preserve cleanliness ; the fetor and discomfort were very great. The disease had commenced when she was nearly eight years old, after a fall ; she was only confined to her bed about four months.

March 7th.—Chloroform was administered, and I bent the thigh on the abdomen with inward rotation ; much crackling and rending took place, but the limb became more flexible, and could be more extended than I had expected ; abduction was not attainable by any force. I therefore passed a tenotome through the skin, just outside the adductor longus origin, and divided all the adductor mass, together with the gracilis, and the pubic part of the fascia lata ; about fifteen drops, as far as could be judged, escaped from the wound. The thigh could be well abducted ; she was put to bed with an arrangement of sheet and sand-bags, which kept the limb abducted, and a weight of three pounds was suspended to the foot.

March 12th.—The upper part of the thigh, for about two finger-breadths, showed ecchymosis. For two nights I had to give her one-third of a grain of morphia, under the skin ; the temperature on the first night was 102.5°, on the second 100°, since then normal. Much care was necessary to prevent her inclining the trunk so as to change the posture into adduction.

March 17th.—Began passive movements ; they seemed very painful.

March 19th.—Gas administered, and for a few seconds limb was moved freely in all directions.

March 21st.—Passive movement much less painful ; permitted her to get up ; showed her how to swing the limb, and nurse how to rub and move it.

May 18th.—Patient progressing well ; she stood with the leg down, very nearly upright; shoe an inch high was ordered.

June 2d.—With the high shoe the patient stood and walked extremely well.

Case LXXXIII.—Jane ——, aged sixteen, was sent to me by the late Mr. Buxton, in November, 1867, with a form of lameness connected not with disease of the hip-joint, but with contraction of the adductors, which entirely precluded separation of the knees ; those joints could not be quite straightened, nor indeed could the hips. She thus stood with the knees bent ; the buttocks protruding and the lines strongly incurved. As the left knee lay a little behind the right, and they could not be parted, the gait was a very singular shuffle, the body and pelvis turning to the right and left each time.

I have seen a number of these deformities, but never without some vulvitis, with vaginal leucorrhœa, enlarged clitoris, protruded nymphæ, whether as cause or consequence we need not inquire ; and in all cases except one, the intellect was weak and getting weaker ; in the exceptional case hysteria was excessively developed.

Jane ——'s mother was informed of the necessity for operation, and on December 4th I, assisted by Mr. Buxton, divided all the adductors, straightened the knees and hips, and put the patient to bed with thighs well outstretched.

December 7th.—Very slight ecchymosis at the upper part of the thighs. Had one-seventh grain of morphia by the mouth on the night of operation.

December 23d.—Has been up for the last three days and was learning to walk well; she was always to be put to bed for three months with the limbs thoroughly apart.

Case LXXXIV.—The exceptional case, which was hysterical but not weak in intellect, was brought to me by Mr. Clifton of Leicester, who assisted in the operation, which was fairly successful.

Case LXXXV.—William D., aged twelve, came to me for admission into the Industrial Home for Crippled Boys at the end of October, 1879. When five years old he had a fall, and was confined to bed with hip disease for nearly a year. Three years after the accident he began to get about on crutches. Further history is unattainable.

I found bony anchylosis of the hip, the thigh at a right angle with the pelvis; it was also adducted. There were two scars of healed sinuses above the trochanter, and four on the outer aspect of the thigh a little below that process. The boy had evidently had extensive suppuration about the hip; the condition of parts showed that considerable changes in the shape, length, and direction, of the cervix femoris had taken place. The lameness was excessive; even when he walked on crutches the lumbar lordosis was strongly marked. If he tried to put the foot to the ground, he could only succeed by bending the other knee, giving a singular twist to the pelvis, and such a curve to the spine as made the posture approach the impossible. I sent the lad to the hospital, feeling sure that the deformity and lameness might be greatly mitigated.

On October 30th I divided, in the manner already described, the femur above the lesser trochanter, using a large curved needle to pass the silk ligature. The leg was brought down nearly straight. He was put to bed and a weight attached to the foot. After a few days, a pillow placed under the nates allowed of further straightening the limb. The boy had no bad symptom, and but a very slight amount of pain. His temperature rose but once as high as 101.2°.

December 3d.—He was allowed to get up and go about on crutches until a proper boot was provided. There was firm bony union at the place of section, and as soon as the bootmaker had done his work the boy was discharged.

December, 1880.—He is now running and walking about very well, and with but slight limp.

Case LXXXVI.—Mr. L., aged twenty-nine, called on me February 9, 1878, with an anchylosed elbow-joint. The disease began six years previously with an injury produced by falling on the ice backward, with his arm twisted behind him. Considerable pain and inflammation ensued, and lasted for six months.

When I saw him he complained of the inconvenience of the straight position, but of no pain. Both upper and forearm were much shrivelled. The movements of the fingers were perfect. I found true anchylosis: no mobility in the direction of flexion and extension, but rotation to about half the normal amount remained.

February 12th.—Chloroform was given, but no flexion nor extension, although I used all justifiable power, could be obtained. I succeeded, however, in gaining rotation of the hand to nearly the full extent.

March 1st.—I made an incision about a quarter of an inch long above the outer condyle, and behind the condyloid ridge, introduced a chisel, and cut toward the middle of the bone in a slightly forward direction. Another incision of equal length was practised above the inner condyle, so that two-thirds of it lay in front of the condyloid ridge; the chisel passed into the

same periosteal wound, was directed outward, with a slight inclination backward. When the instrument was removed, the rest of the bone was broken with considerable ease, and the shape of the fracture was favorable, being directly transverse. Barely a drachm of blood was lost. The limb was, while traction was exercised, placed in a rectangular position on an anterior metal splint, and enveloped in a firm starch bandage, painted with paraffin.

March 2d.—At eight P.M. last night the patient was suffering a good deal of pain. His temperature was 99.5°. He had half a grain of morphia injected under the skin, and passed a quiet night. In the morning, at 9.20, his temperature was normal.

March 5th.—Wounds dressed on 4th, looking healthy. No pain and no morphia. Allowed this day to get up : arm carried in a sling.

March 9th.—Wounds healed. He sat up, and walked about the room four hours—to move, bend, and manipulate the fingers.

April 1st.—Removed splint. Arm at a right angle, very excellent union. Patient delighted to get his fingers to his mouth.

CASE LXXXVII.—John B., aged eleven, came into Charing Cross Hospital with a knee falsely anchylosed at a right angle. In consequence of old disease there were many cicatrices about the joint (Fig. 68). The

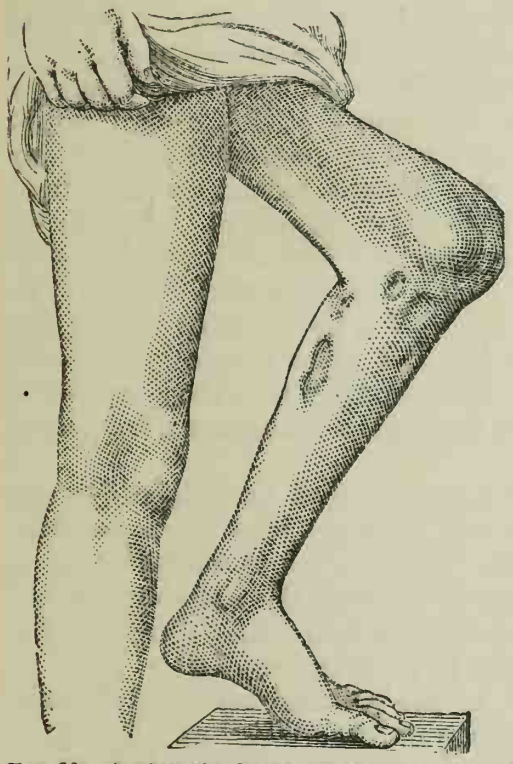

FIG. 68.—Anchylosis of knee. Posterior subluxation.

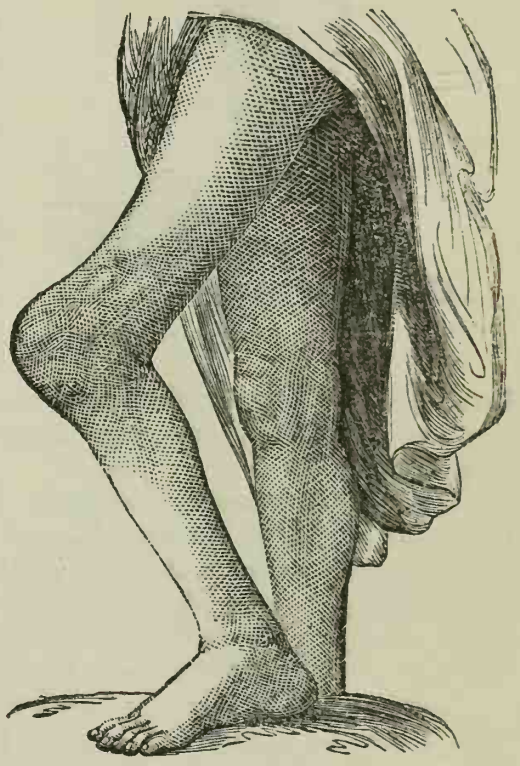

FIG. 69.—Result of first operation.

condyles of the femur had become elongated into that form which renders forcible extension impossible, without producing at the same time posterior dislocation ; nevertheless, I thought it only right to try if some reposition of parts might, under chloroform, be effected. Although both hamstring muscles were divided, it was found impossible to alter the angle at the knee. As soon as straightening began, the tibia commenced to glide backward toward the popliteal space. After about a week, the puncture for division of the outer hamstring suppurated. The mother of this lad, re-

siding in Ireland, positively forbade, through the lady who asked me to take him in, any operation for the removal of parts, though, as long as nothing was taken away, she did not object to any measures for straightening the limb. I was thus limited to a proceeding I might not otherwise have chosen ; nevertheless, the soft parts about the knee, and the lower end of the femur, though not diseased, were hardly sound enough to embolden me to cut through them ; I, therefore, determined to divide, firstly that bone a little higher, and after an interval, to cut through the bones below the knee.

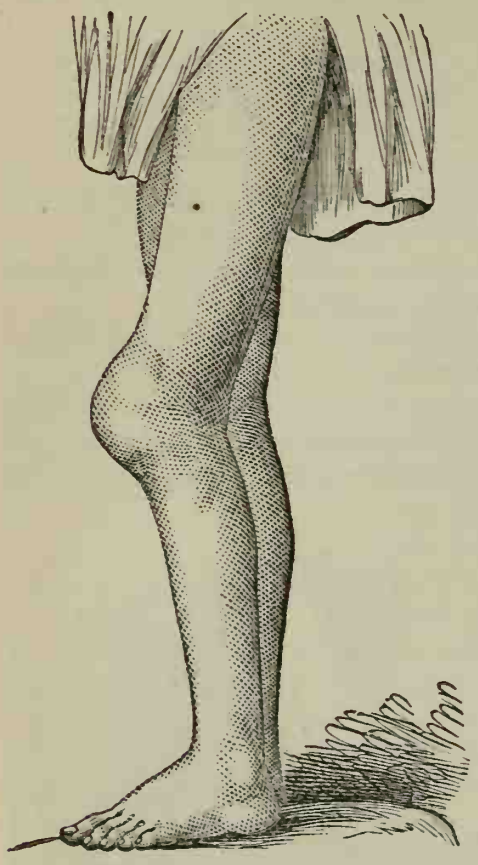

FIG. 70.—Result of second operation.

January 25th.—I cut through the femur about four inches above the joint, and put the limb into plaster-of-Paris, with such bend of the femur as seemed to promise, after the second operation, most straightness of the limb with least subsequent projection of the knee. The result is here seen (Fig. 69). The bone had become firmly united, and the splintage was removed on March 1st ; but owing to certain circumstances unconnected with the case, I could not perform the second operation immediately.

March 15th.—I divided the tibia and fibula : the former from a wound on its outer side just below the tubercle ;[1] the latter also from a wound on the outer side below the transit of the external peroneal nerve. The limb was straightened ; owing to the plaster-of-Paris supplied being of a poor quality, it did not fix quickly, and some subsequent flexion took place. However, the bones reunited well ; on April 12th the plaster was removed, and the photograph from which this figure is engraved was taken (Fig. 70).

I will only remark that, even in the few days that had elapsed since then, the angles at section-place of femur and tibia are very much decreasing, as also is the projection at the knee. Nature seems undertaking a modelling process which, in time, will almost abolish the angular appearance. As it is, the left limb is only about an inch and a half shorter than the other, and when he has a high shoe the boy walks very well.

August.—This boy was brought back to me walking remarkably well, with a shoe an inch and a quarter higher than on the other leg. The projection at the knee had very much decreased—was, in fact, barely perceptible.

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[1] I now prefer dividing the tibia from the inner side, as stated in text (p. 377). This, my first case, is the only one I ever divided from the outer angle.

CHAPTER XIX.

ON SOME DEFORMITIES OF THE KNEE.

Although the ensuing chapter may not, in the strict sense of the title, be admissible into this treatise, yet the subject is cognate to joint disease, and the matter of very considerable interest, therefore a few words on certain deformities, and more especially on those about the lower limbs, will not be out of place.

Firstly, we will consider the two opposite distortions, named respectively, genu extrorsum and introrsum, commonly called varum and valgum. The former of these is produced by certain bends of the thigh and leg-bones. Usually in rachitis both the femur and tibia are bent, each of them, into S-shaped curves; the upper half of the former is convex outward; the lower convex inward. While the tibial inflexions are the reverse, namely, convex inward above, outward below. Thus the curves compensate each other; the hip, knee, and ankle lying, all of them, on the perpendicular line about which each bone waves. In genu extrorsum the lower curve of the femur and upper one of the tibia are wanting; the compensation which in ordinary rachitic distortion puts the knee upon a straight line drawn from the hip to the ankle being absent, that joint is outside the perpendicular of the limb. Hence, when walking, the patient, in order to throw the weight properly on that joint, must sway the body from side to side in a very clumsy and awkward manner. There is in such cases no sign whatever that the epiphyses proper are deformed.

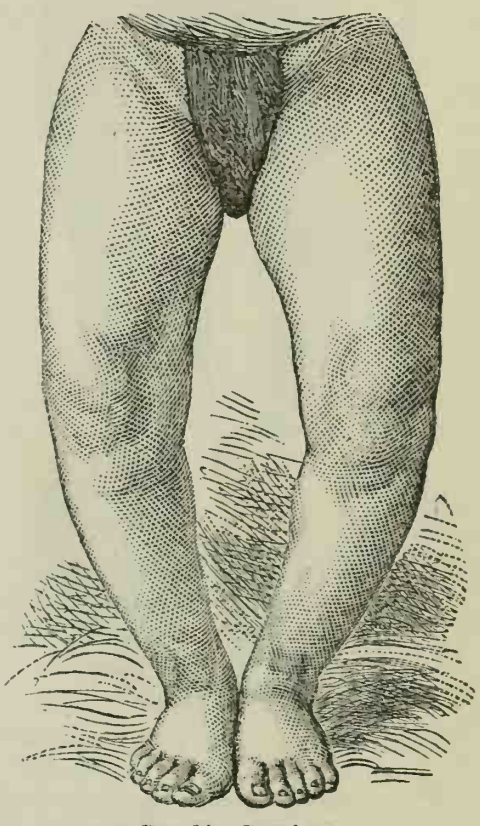

Fig. 71.—Bow-legs.

In such cases I have several times divided the bones (femur, also sometimes tibia and fibula) and straightened the limb. The first case in which I performed this operation was that of

Case LXXXVIII.—Elizabeth E., aged seventeen, was admitted under my care into Charing Cross Hospital, March 27, 1880. The strong curve of the lower limbs was a serious trouble to her; she could hardly walk, since at each step she had to throw her body so far over that she either fell or had to grasp some object for support. Crutches she could not use at all, since they prevented the sway which enabled her to place the weight of the body over each knee alternately. Fig. 71 gives a fair idea of her limbs. It may

be added that when she stood with the malleoli in contact the knees were just over 6¾ inches apart.

April 12th.—I divided with the chisel on both sides the fibulæ (obliquely), and then the tibiæ—about an inch below the head of the one, and the tuberosity of the other, and put them straight in plaster-of-Paris.

May 3d.—Neither pain nor fever resulted from this operation. There was good union a week previous to the above date, and I should have operated then had not other circumstances intervened. To-day I divided both femora, where the bend of the bone was most marked, namely, a little above the junction of upper and middle thirds. The limbs were put up in plaster-of-Paris. She was placed on a fracture-couch, which obviated any necessity for movement.

June 10th.—Plaster removed; union of the left thigh perfect; that of the right was less strong, and the limb was placed on a MacIntyre splint.

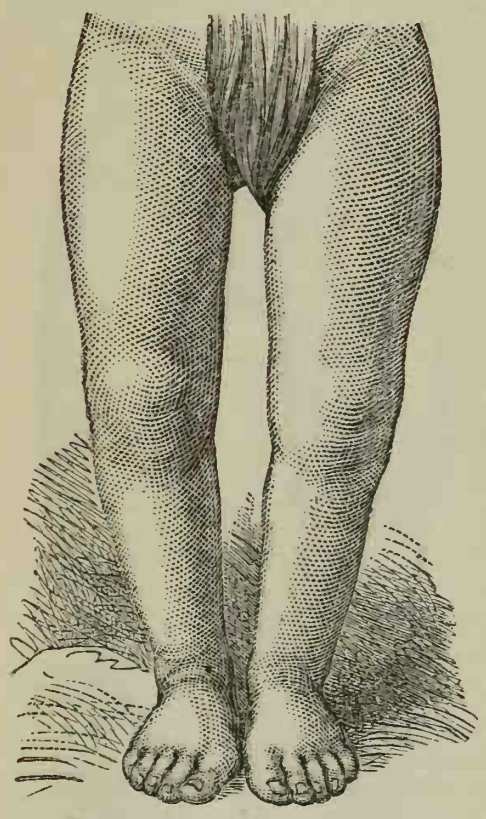

FIG. 72.—Bow-legs straightened by operation.

July 3d.—Patient, who had been for a week past released from all splintage, was got up to-day and placed on crutches.

July 30th.—She could at this date walk very well, balancing rather than supporting herself with crutches. Another patient called to her rather suddenly, she was startled, turned quickly, fell, and broke her right thigh obliquely, about an inch and a half above the artificial fracture.

This second fracture did not do so well as the one I had purposely made: it was very difficult to prevent riding, and to keep the bone straight. The progress was slow, and the result a slight bend forward at this part, and a shortening which the original section had not produced.

December 28th.—She left the hospital able to walk well, and with the limbs very fairly straight.

I have frequently seen this patient since. She is strong and hardy, able to walk considerable distances without discomfort and without sway of the body.

In less severe cases division of so many bones is unnecessary; it suffices to divide the femur a little above the epiphysal line. Careful examination as to participation in the deformity of parts above and below that articulation will guide the surgeon as to his choice of operation.

Genu extrorsum may be either double or single, or on the one side there may be genu valgum, on the other genu varum; this latter condition is extremely ugly, producing an exceedingly awkward, waddling form of limp.

CASE LXXXIX.—February 19, 1880.—I divided both femora of Jane M., who begged me to put her legs straight, the left one being bowed outward, the right inward. The deformity of neither leg appeared sufficient to require section of the bones below the knee.

The limbs were encased in plaster-of-Paris for twenty-two days and then

released. No pyrexia followed, and a small dose of morphia was given hypodermically the first night; but after this, as she had no pain, such medication was unnecessary.

March 13th.—The knees were, when the plaster was first removed, more stiff than I have ever seen them after so short a term of splintage.

March 19th.—Passive movement and swinging the legs with a weight attached rapidly relieved the stiffness. She walked this day with crutches.

April 2d.—Has been for some days walking with one stick.

May 31st.—The patient walked without any waddle into my consulting room; the legs are strong and straight.

For *genu valgum*, or knock-knee, a number of different operations have been proposed and practised. They resolve themselves into three forms: cutting off the internal condyle; removing a wedge of bone from the inner side of the femur; division of the femur. The former is Dr. Ogston's method; that surgeon used the saw. The operation has been extensively practised both here and in Germany. Mr. Reives modified the procedure by adopting the chisel and beginning the osseous section at the upper aspect instead of at the front of the condyle, whereby he hopes to avoid opening the joint. When the section has reached almost to the cartilage, the leg is forcibly straightened, by which means the parts of the bone left undivided are broken through, and the condyle is forced upward upon the shaft of the femur. In a little while the separated condyle reunites in its new position, which permits the leg to sit straight upon the thigh. This operation rests on the idea that the inner condyle has grown to an abnormal length; certainly that part lies at a lower level than the outer condyle, but not from hypertrophy. Perhaps the very considerable alteration in shape of the femoral surface in the knee-joint—the ridge and furrow, which such pushing up of the condyle must cause, may become modified in time; but a feeling of uncertainty as to the ultimate state of the joint in after years does pervade my mind, and I have a strong preference for leaving healthy knee-joints intact. Dr. MacEwen's first method, by removing a wedge from the inner aspect of the femur, effects this. I should think the wound which would permit extraction of such a wedge must be rather large.

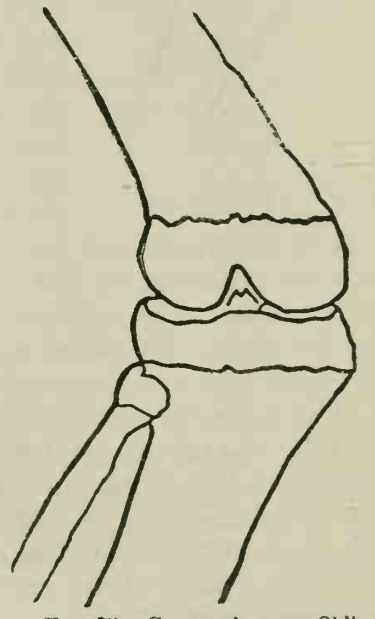

FIG. 73.—Genu valgum. Obliquity of shafts on normal epiphysis.

The mode which I employ, and have exclusively practised, is by direct division of either thigh-bone, or of leg-bones, or of both, according to circumstances and the severity of the case.[1] What opportunities I could find for examining the bones of individuals, who had been during life thus dis-

[1] In a recent work Dr. MacEwen refers to my papers as though it were my "principle" to perform a "triple osteotomy"—a remarkable error. I have advocated from the first osteotomy across the femur; only when necessary of the leg-bones also. He modified his wedge into simple section, apparently only at first for slight cases, on February 2, 1878. I performed my first section (*femur only*) February 14th. He has therefore priority; but the work of both (his paper appeared March 30th) was independent and original.

torted, led me to consider that the lower level, at which the inner condyle lies, is due to an obliquity of the end of the diaphysis, which causes the epiphysis to sit aslant. Moreover, if in a living knock-kneed person, the surgeon trace down the inner and outer aspect of the femur with the fingers of both hands, until they are checked by the upper projection of the condyles, he will find that the fingers on the inner side lie a good deal lower than those on the outer; and hence will perceive that the internal condyle is not in reality larger than the outer.

Fig. 74.—A typical case.

Some time after I had introduced this operation, and given my reasons for doing so, Dr. Mickulicz, of Vienna, published an exhaustive paper on the "Anatomy of Genu Valgum,"[1] which clearly demonstrates that the epiphysis and the condyles are normal, but sit obliquely on the shaft of the tibia and femur respectively. A glance at the figure shows this condition; be it observed that the epiphysis is, on femur and tibia equally thick; but the diaphysal junction is oblique, *i.e.*, the shaft of the bones sits in such wise upon these epiphyses, that the inner angles are acute, the outer obtuse; whereas they ought to be equal and nearly rectangular. The outline here given (Fig. 74) shows, I think, this condition pretty clearly; it was obtained by placing the limb flat upon a piece of paper laid over a board on the bed, and tracing with a pencil, avoiding pressure on the soft parts. The form of the knee itself is seen to be normal, which could not be the case if the deformity depended upon a difference in thickness of the inner and outer portions of the epiphysis.

The operation of cutting off the internal condyle does not take the nature of the deformity into account; it adds to the original abnormity another, which is intended to act as a compensation. Removal of a wedge from the inner side is more physiological, and, if one could be quite sure of removing a piece of the exact size required, would, no doubt, procure a perfectly straight limb. The mode of treatment which I have advocated—that by entire division of the bone, or, when necessary, of the bones—leaves, after rectification, a V-shaped gap on the outer side, produced by putting the limb straight, and therefore necessarily of the exact size required. In all my cases nature has perfectly filled this space, leaving neither weakness nor any tendency to recurrence of the deformity. As, for instance, in the subjoined outline, which is the same limb as that traced in Fig. 74, after five weeks' treatment, the femur only being divided.

Fig. 75.—Result of osteotomy.

One advantage of this method, for a goodly number of cases, lies in the fact that the distortion is often not purely a knock-knee; but is combined of this, together with certain twists of the bones upon their axes. The femur is sometimes wrung a quarter of a turn outward, the inner condyle presenting in front, or both bones are bent, so that the patient appears unable to straighten the knee, although that joint is normal. The

[1] Archiv der Klinischen Chirurgie, Bd. xxxii. 3tes Heft.

operation by entire division of the bones is the only one that can rectify all these conditions; but in the latter case the flexors shortened to fit the limb in its curved condition sometimes require section to allow of complete rectification.

The method which I advocate is division of one, or sometimes of both bones, beyond the epiphysal junction, with a chisel. I prefer performing the operation antiseptically, because the wound, although small, is still too large to justly confer the name "subcutaneous" upon the operation. If the case be not severe, a careful examination should determine whether the tibia or the femur be most in fault. It is nearly, though not quite always, the latter which should be divided. If the distortion be more marked, the bones both above and below the knee must be severed.

For section of the femur, turn the patient on the other side, let the inner condyle be supported on a firm block, protected by a fold or two of lint. Choose a place at proper height a little way behind the ridge which subtends the outer articular facet; sink a scalpel to the bone, making a horizontal incision the breadth of the chisel (half an inch), keep the knife in the wound, and glide the chisel along it till it is in firm contact with the bone; tap it at first gently, then move powerfully with the mallet, directing it straight across, forward and backward, until all the interior of the bone is divided, avoiding injury to the periosteum in all parts, except where the chisel enters. During these procedures the tool will have to be loosened frequently. It should not be allowed to get jammed, for should it do so, efforts at release will probably jerk the instrument out of the osseous, perhaps also out of the skin wound. Should this mischance occur, an eyed-probe or a blunt-ended knife should be cautiously passed into the bony incision, and the chisel carefully glided along it. Great care must be taken to hit the right place, lest a thin slice, which would afterward necrose, be detached. When the chisel has done its work, a little jerk inward of the leg snaps the remaining shell of bone; and if no other part has to be divided, the limb is put straight in plaster-of-Paris. If the case be sufficiently severe to call for section also of the leg bones, the deformity should be rectified only to half, or to such proportion as may be deemed lies above the joint. In three weeks the rest of the cure may be undertaken; I have never, save once when catamenia intervened, waited longer, and sometimes have only allowed sixteen days to elapse.

In dividing parts below the knee, I prefer to cut both bones. The fibulæ of rickety children are sometimes very thick, and are, in cases fit for operation, always so hard as to be fractured with difficulty. In one case the late Mr. Maunder told me he trusted to forcible fracture. This produced very severe bruising, and he doubted whether the bone was really broken or subluxated. The upper part of the fibula may very readily be divided about an inch below the head. The section should be oblique from before backward, permitting the fragments to ride. The tibia is best divided from the inner posterior angle just below the tubercle, where it begins to get thin. (See p. 377.)

A few words should be said about the choice of case. Section of the bones should, as a rule, be avoided while they are still flexible to manual pressure, or before the seventh year. But to this axiom there are several exceptions; as when the deformity is on one side only, or, *à fortiori*, when on one side the outward, on the other the inward, malposture pertains, producing, as it often does, considerable pelvic obliquity, whence scoliosis, of a kind which will hardly be curable if the child be rachitic, as in such deformity, is almost always the case.

The child, whence this plate is taken, controverts one of these rules, since she was younger than I should, as a rule, choose for osteotomy, viz., seven years; but the distortion was very severe, and the bones did not yield to any pressure that I could bring to bear upon them. The figure also illustrates what was said at p. 386 regarding a superadded twist of the bones. The right femur, as also to a less extent the tibia, are thus wrung outward, while a slight fault in the contrary direction was marked on the left side.

After section of the bones, which were very hard, the greatest care had to be taken to get the different points of bone in exactly symmetrical situations on each side, first for the femora, and sixteen days afterward, when the bones below the knee were divided, for the malleoli. It will be seen by the plate (Fig. 77) that my success was not mathematically accurate, since

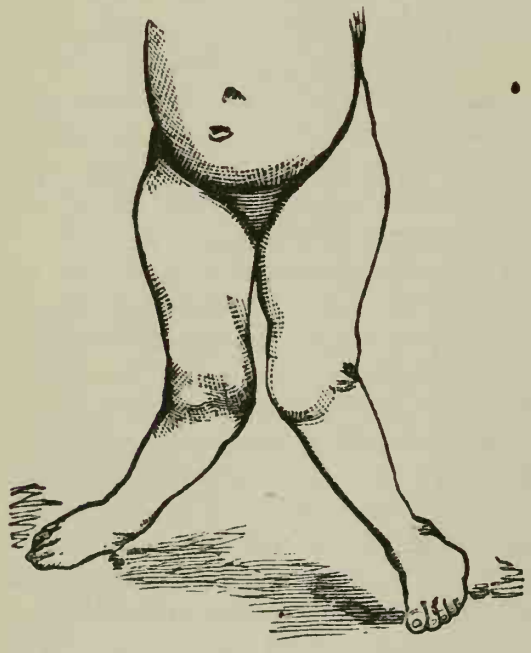

FIG. 76.—Genu valgum, with subsidiary twists.

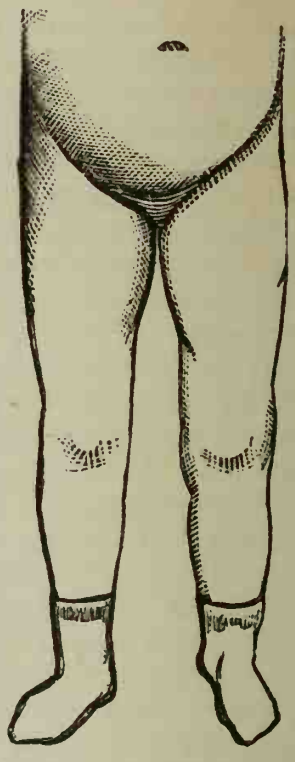

FIG. 77.—After eight months.

there is still below the knee a slight outward twist, which, however, is barely perceptible, save to a careful observer already acquainted with what he is to look for.

Occasionally, in very severe cases, it is necessary to sever the ilio-peroneal band of the fascia lata; but if the fibula be, as I recommend, divided, there is no occasion to cut the biceps tendon, save for flexion. In conclusion, I must, in terms of the strongest condemnation, refer to division of the external ligament for this deformity. A mere glance at Fig. 72 will show that, since the evil lies in the bones, section of such ligament can only permit straightening of the limb by forcing open the outer portions of the knee-joint, to the extent of an inch and a half, if the femur be eleven inches long and the deviation be seven inches. The child is not, therefore, very likely to escape traumatic synovitis. I know, however, that in a certain way such procedure may be plausibly represented to the uninstructed laity as much less severe than, or a mere trifle compared to, osteotomy; but such statement is directly the reverse of truth. A patient whose thigh-bones have been

severed has to rest in bed three weeks, or if both thigh and leg bones have been divided, six weeks, and then may begin to practise movement and walking with no other aid than, for a week or a fortnight, a pair of crutches. The child, who has been so unfortunate as to have her lateral ligament divided, will have to be carried by some other person, or very strongly supported in a pair of very heavy instruments, extending from waist to foot, for two years ; and even after that time the possibility of bearing any weight upon the joint is more than doubtful—inability ever to leave off instruments hardly doubtful.

CHAPTER XX.

ON THE REMOVAL OF DISEASED JOINTS.

General.—A. *On the Circumstances which justify Removal of a Joint.*—There is a certain state and period of joint disease, which not only warrants the surgeon to recommend removal of the part, but which renders any other course unjustifiable. The variety of circumstances which call for operative interference, may be summed up in the following manner.[1] Removal of a joint may be called for: to save life in the height of an acute disease; to shorten the wearing processes of a chronic and incurable disease; to rid the patient of a deformity and encumbrance.

In the first of these the surgeon is called upon to form a rapid decision, and to act upon it. He has nothing to do with collateral considerations, but has simply to judge: Whether the system will succumb to the disease before the part can be restored?—and, Whether the patient's condition is such as can sustain and will be benefited by operation? The answer to the first question must be decided according to the principles of general surgery, whose consideration hardly comes within our scope. The amount of febrile excitement and exhaustion must be contrasted with the amount of power, and the result compared with the quantity of local repair necessary before the violence of the irritation will be subdued, and with the probability of so excited or depressed a system performing those actions at all. It must be remembered, that few local surgical conditions can be worse than a joint acutely suppurating, the cartilages detached from the inflamed bone, the deep cavity full of purulent matter, with great tendency to putrefaction; the bone cancelli filling themselves with pus, the limb swollen by acute œdema, the patient almost prostrated by pain. The general condition is that which always accompanies such local manifestations: a low typhoid fever, ending very probably in purulent infection. We have seen that in the early part of suppurating synovitis, free incisions into the joint at some depending part greatly relieve all the urgent symptoms, and may save the limb. Such treatment is most likely to be successful in the commencement of the disease; its value, and the chance it may afford, are not to be neglected; if, after a time, the oppression of system be diminished, we may postpone the consideration of operation; and if ultimately that last resource must be resorted to, the patient, being in a less oppressed state, will bear the operation better. If a free outlet for the pus do not speedily reduce the pyrexia, removal of the part will probably be the only hope; and while the surgeon should not hurriedly decide to sacrifice the limb, neither should he postpone his decision until danger from blood-poisoning is imminent.

In considering the state of parts implicated in a suppurative synovitis, we have very much answered the question, as to whether operation can put

[1] Malignant and sarcomatous disease are not noticed.

the patient into a more favorable position. Certainly, the clean edges left by the blade are much more tolerable to the patient than the condition above described; and when the remaining systematic power is considerable, it frequently happens, that within twenty-four hours after operation, the typhoid symptoms have disappeared, and the patient seems restored to life. On the other hand, when vitality has been much depressed, there is hardly any rally, the wound suppurates unhealthily, does not unite, and the whole condition appears hardly improved by the operation.

But if rigors and other symptoms of pyæmic poisoning have already supervened, and if the thermometer mark above 102°, the patient is not in a state to bear any severe operation with impunity. I should, under such circumstances, strongly insist upon the expediency of using such measures as have been already inculcated (p. 80 et seq.), and awaiting a period, even though it be only an interval, of lower temperature, and less infected state of system.

The difficulty of accurately and justly judging, under the circumstances above noted, becomes facility when compared with the discernment to be used when a chronic disease has entered into such a stage that operative interference comes at all into question. The slower form of malady allows the surgeon a longer time for decision, so that he can perhaps pit and try the reparative powers against the morbid state. But these form by no means the only problems; indeed, so many points must be considered, all of them bearing with different weight and in different directions upon the subject, that it is scarcely possible to epitomize, within a small compass, the mode in which removal or non-removal should be considered. The most essential questions are: is the condition of internal organs so healthy and is the constitution so unbroken that we may reasonably look forward to cure of the disease? If so, will the limb be of value, or an encumbrance? In the worldly circumstances of the patient, is it possible for him to await a long, and perhaps a doubtful, process of cure?

The first of these three queries, that on which the others hang, is most difficult to answer whenever there is such a nice balance between disease and health as to render the issue doubtful. Of course we have the same comparison to make between the constitutional vigor and the repair necessary, but both points are very difficult of judgment, and must be separately estimated before they can be contrasted. In the first place, the diathesis, whereto the long continuance of the chronic disease is owing, must be taken into account. A rheumatic malady connotes one constitutional evil, a strumous disease another; and the effect upon the system of allowing the persistence of a topical evil is different in each. It has been already pointed out (p. 147), that persons suffering from the former kind of arthritis are liable to a peculiar form of bronchitis, and we know that in such diathesis atheromatous degeneration of the arteries, or disease of the heart, is a common occurrence. It would be false to affirm, that the joint disease had any direct effect in causing such changes, but the irritability, confinement, and wearing of the system, which are always produced by long continuance of a joint disease, certainly place the body in a condition which favors the progress of such morbid changes. The effect, however, of local rheumatic disease upon the general system, is much less marked than that of a strumous malady. Some persons look upon the scrofulous diathesis as an entity, which necessitates diseased action somewhere, and they even believe that, by removing its manifestation in one part of the body, we only transfer its appearance to another place. The actual fact is, it seems to me, very different; indeed, as I believe that scrofula does not consist of a *materies morbi*,

which must have exit, but in a state of ill-nutrition, it follows from such credence that anything which draws largely on the sustaining power of the system, must of necessity be held to increase the nutritive fault. In watching cases of strumous joint disease it is impossible to avoid being impressed with the relation between the demands on the system made by the original disease, and the establishment of fresh strumous phenomena, in other, generally internal, organs. Therefore, to sum up, we watch in acute and subacute suppurations for pyæmia, in chronic suppuration for lardaceous disease, in chronic rheumatism for bronchial, cardiac, and vascular troubles,[1] in strumous disease for pulmonary and cerebral complications.

Of some of these conditions the signs have already been given. But opportunity has not as yet been found for some necessary remarks concerning lardaceous disease,[2] an accompaniment or sequela of long-continued suppuration. No sign marks its first onset, until hyaline casts, if the kidney be attacked, appear in the urine, or until a harsh skin, getting increasingly duller, and more of a yellow clay-color, mark implication of the gradually enlarging liver, while a somewhat similar, but less yellow tinge, of conjunctiva and skin, together with increase in size of the spleen, give sufficiently early signs that this organ is involved. Examination of patients undergoing prolonged suppuration should be repeated every fortnight or three weeks; the investigation is to include general aspect and color, size of liver and of spleen, albuminous urine and (microscopically) the presence of casts. I weigh with the more insistence on these points, because a number of cases have shown me that lardaceous disease of the two first-named glands, even though the organs be much enlarged, will usually get well, if the focus of suppuration can be at once and entirely eliminated; while concerning the kidney some distinction must be drawn, because the mere presence of the barely organized fibrin-deposit may have so interfered with the minute structure, may so have blocked the tubules of the gland that resumption of function cannot be rapid enough to obviate uræmia. If then the amount of urine passed in the twenty-four hours be not far removed from the norm, if the amount of albuminous contents be not large, and if the hyaline casts be few and of the larger size, the patient may, suppuration being checked, recover perfectly and rapidly. If the contrary conditions exist, namely, scant urine, with large admixture of albumen, and small as well as large hyaline casts, the patient will succumb to operation. If the urine contain albumen persistently, but no hyaline casts, the case is very unfavorable.[3]

Case XC.—Caroline L., aged seven, was in the hospital when, on Mr. Hancock's retirement, I undertook charge of the wards, and that surgeon had, twenty-one months previously, excised the head of the femur. The child at the time of operation was much emaciated, and her thigh especially extremely thin. In endeavoring to turn the caput femoris out of the socket the shaft of the bone broke in two places; and when cut through beneath the trochanters, the bone was found reduced to a mere papery shell. She suffered profuse discharge from the wound, but escaping with life, was after some months sent to the seaside, and returned with the wound still discharging.

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[1] I am convinced of the correlation between rheumatism, atheroma, and aneurism; but this is not the place to discuss the subject, of which a fuller exposition will be found in my work On Aneurism, especially of the Thorax and Root of the Neck.

[2] The term "amyloid," being founded on error, ought to fall into disuse.

[3] I say persistently because occasionally the presence of albumen is merely a transient condition, which the examining surgeon may perchance have hit upon.

In July, 1872, when I took charge of the patient, I found her of a yellow clay color, with harsh furfuraceous skin, extremely emaciated, with night-sweats, no appetite, and living on stimulants. The liver filled the whole right side of the abdomen, its lower edge being lost within the crista ilii; it extended far to the left of the middle line; the spleen was large. The urine was sufficient in quantity; it contained albumen and some hyaline casts, none of which, however, were of the smaller size, and were mixed with endothelial cells.

November 2d.—I amputated the whole limb at the hip. She made a rapid recovery; the wound did not suppurate; the liver and spleen very rapidly diminished in size, the albuminuria ceased, and she left the hospital, fat and strong, on February 1, 1873.

September, 1880.—I had seen this girl twice since the amputation. She grew very rapidly, and was remarkably strong and large. During the month above named I heard of her, that she was a large, strong, and remarkably healthy woman.

So much has been said in previous chapters of the different local conditions produced by articular disease, that little beyond a short summing up is necessary. Rheumatic synovitis, less commonly than the strumous, induces a state which requires removal for the sake of saving life. The non-suppurative and non-degenerative quality of joint disease, arising from or prolonged by that diathesis, has been discussed. The patient who is affected by such malady, does not suffer from the wasting effects of large abscesses and drains upon the system; but, on the other hand, such maladies do not often tend to cure by obliteration of the cavity when the cartilages have nearly or entirely disappeared, but they produce very considerable pain and sleeplessness, thereby setting up an amount of irritative fever and tendency to arteritis. This latter condition must be taken in connection with the difficulty of cure, and be weighed against the absence of physical drain caused by the malady, and the fact that throughout the disease exacerbations and ameliorations are to be expected. Arthritis deformans can never justify, or even bring into question, the subject of ablation.

Strumous inflammation, to which by far the larger number of joint diseases requiring removal are due, attacks, as we have seen, primarily either the bone or the synovial membrane; by the time the affection is so advanced that removal of the part comes at all into consideration, the place of origin, as influencing that question, is unimportant. The local conditions, which promise still further impairment rather than improvement, are—plentiful degenerations, encroaching further and further among new tissues; widespread abscess among surrounding parts, and a certain suppurative cachexia, which must be described in the sequel. Many joints have been amputated or excised on account of sluggish strumous swelling, without abscess, or other wasting condition—such state, as a local malady only, the general health being unaffected, does not, as we have seen, necessitate such interference. As long as the subsynovial tissues are granulating, the only fault being want of development beyond the crude cell-formation, it is competent for treatment to produce an action that shall cause some further organization, and thereby improvement. When much of the tissue is degenerating and suppurating, and abscesses form at distances from the seat of injury (the deeper and the closer to the bone the worse is their prognostication), more particularly if fragments of bone come away with the pus, the state is such as may hardly get well without a severe trial

to the constitution; but, if the health hold good, even these local evils should not lead us to despair, for it may happen that some sudden change in the circumstances, some success in treatment, causes a great amelioration in all the symptoms, and the patient gets well with but little further difficulty.

There is another condition, which appears to consist in osteal and periosteal irritation, produced by the presence of diseased structures. Such cases, which begin in the synovial tissues, are decidedly strumous, belonging to the form of that diathesis with fine connective tissues, and run their course more rapidly than the ordinary pulpy disease of synovial membrane. The new tissues are not long persistent: in from six to twelve weeks pus forms in and around the joint, making exit by tolerably straight simple passages; the cartilages disappear rather quickly, leaving generally the articular lamella attached; a probe passed into the sinus finds bare bone all round; the cancelli inflame; their lining membrane does not granulate freely, but abscesses form among certain of the cavities and open outward or into the joint by sharp-edged singular-looking holes in the otherwise even bone-surface. The periosteum becomes inflamed and swollen, the patient complains of pain, and the surgeon finds a deep, hard swelling beneath the muscles, equally diffused all round the bone. This tumefaction may subside and recur several times, but each time it leaves more persistent enlargement behind it. At last, if operative interference be still postponed, abscesses form, both in and around the periosteum; caries (generally caries necrotica) commences in the end of the bone, and spreads even a long way from the original seat of disease. Such local disorder is always accompanied by a corresponding fever and depression in health (suppurative cachexia), so that in such cases the joint can hardly be saved, while, by delay, health or life may be sacrificed.

There is in all diseases so close a relationship between local manifestation and constitutional condition that it is barely possible, and certainly not judicious, to consider the former without reference to the latter. In a few cases of even very far advanced joint disease the constitution will remain so little affected that the surgeon may rightly postpone operative interference, hoping that yet a change for the better will, as sometimes occurs, set in. Yet even in such case, even if it be deemed probable that the joint or limb may be saved, two further considerations must be weighed—firstly, the important one of time, which to many is worth more than money; secondly, the condition in which the limb must be left; whether, namely, when all shall be accomplished—abscesses healed, inflammation conquered, and pain subdued—the part saved is of use, or merely an encumbrance.

B.—*On Amputation and Excision performed for the Removal of Diseased Joints, and the Causes of Preference for one or the other.*—It is not very many years since that, whenever it was deemed necessary to remove a diseased joint, the limb was amputated;[1] but about a century and a half ago, a change in this respect began, and the possibility of removing the diseased portion, without sacrificing the entire limb, came into consideration. The first notice of any case of removing a portion or the whole of a diseased joint, that I can anywhere find, is reported by John Daniel Schlichting, M.D., in 1742; the surgeon who performed the operation, and whose name the doctor does not think it worth while to give, extracted the head

[1] The shoulder and hip must be excepted.

of the thigh-bone in a case of hip-joint disease.[1] It is probable, however, that the head was separated at the epiphysis, as no mention of the use of a saw is made. No deduction is drawn as to the repetition of this operation on the same or other joints.

In 1768, Mr. White, of Manchester, removed the head of the humerus for caries;[2] subsequently, four inches of the shaft exfoliated; yet there was only an inch of shortening, which Mr. White attributed to the weight of the limb dragging it down, as "it was only suspended by a common sling, and the patient not at all confined to his bed."

In January, 1774, Mr. Bent, of Newcastle, published[3] the case of a woman from whom, in 1771, he had removed the head of the humerus for caries. The patient walked away from the surgeon's house to her lodgings, and appears to have worn no apparatus except a sling.

In October, 1778, Mr. Orred, of Chester, read before the Royal Society[4] a case in which he had removed the carious head of a humerus with success.

These are the first recorded cases of resection of the joint-extremities of bones, or decapitatio ossium, that I can anywhere find. M. Velpeau, indeed, in his "Médecine Opératoire," vol. ii., p. 703, remarks that in 1740 Thomas, of Pezenas, had successfully extracted the head of the humerus. Guthrie[5] relates this case. The surgeon had enlarged the opening into an abscess; two or three days afterward the necrosed end of the bone presented at the wound. About that time several French surgeons[6] make mention of extracting the splinters of the caput humeri, shattered by musket-balls; but such operation is merely removal of splinters, through a wound already existing, and does not therefore come into our subject. We may claim for England the first idea of the operation for removing the heads of bone; but the reader will observe, that the cases above given are not excisions of joints, for only one of the bones entering into the articulation was sawn through, and only one of the joint-surfaces removed: the cases belong to the category of partial resection, or, more definitely, to decapitation of bones (*Decapitatio ossium*).

We may also claim for England the first total resection of a joint, or removal of all the bones entering into its composition. The first published case belongs to Mr. Park, of Liverpool, and the operation was on the knee-joint. It was performed on July 2, 1781, and was, as all the world knows, perfectly successful, the man afterward following his occupation as a sailor. It appears that Mr. Filkin, of Northwick, had actually the priority of Mr. Park, having operated on a knee-joint on August 23, 1762, with such suc-

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[1] The case is thus reported under the title "*Coxæ articuli suppuratio cum secessione coxæ femoris solidata.*—Anno 1730.—Puella rustica, ætat. 14 annorum, coxæ articulus tumescit, dolet, suppuratur, perrumpitur. Chirurgus dilatat foramen naturâ factum, extrahit totum ossis femoris caput. Subjecit posthâc in ulceris cavitatum *Myrrhæ tincturam* porro *fuscum Ung. fel W.* stringat eam, denique arcto vinculo raro deligat, atque sex septimanarum curriculo consolidat, ut puellam postmodum libere liceat manca inseperit." Philosophical Transactions, vol. xlii., p. 274. Here follows a rough diagram of the head and neck of a thigh-bone which shows the epiphysis only to have been removed.

[2] Phil. Trans., 1769, vol. lix., p. 39. and Cases in Surgery, p. 57. I put this case before another, because it was first published.

[3] Phil. Trans., vol. lxiv., p. 353.

[4] Ibid., p. 6.

[5] On Gun-shot Wounds, p. 473.

[6] Boucher: Observations sur les Plaies d'Armes à feu. Mémoires de l'Académie de Chirurgie, t. ii. MDCCLXIX., p. 287.

cess that by November 21st the patient was so well as to need no further attention. He was alive in 1783, and the operator's son proposed that he should call on Mr. Park. In the pamphlet which Mr. Park published on his cases, he proposes this operation for the elbow, and M. Justamonde, taking the hint, performed a partial resection of that joint. At this point the operation was taken up in France by M. Moreau, de Bar-sur-Ornain, who, between the years 1786 and 1798, excised the shoulder, elbow, knee, ankle, and tarsal joints. Thus, at the beginning of the present century, the possibility of taking out a joint and saving the rest of the limb was firmly established, and the practice has continued in different countries with a variable and fluctuating vitality ever since. On the Continent, both in Germany and in France, many operations of this sort were performed. Textor, Müller, Jäger, Roux, and others, had successful cases ; but in England the practice fell into disuse, so that Sir P. Crampton's operation in 1822, and Mr. White's (of the Westminster Hospital) case of removing the head of the thigh-bone, was quite a revival of the method. The present generation of British surgeons is indebted to Mr. Syme for the last revival of excision of joints, and to Mr. Fergusson for its extension, particularly to the hip and knee-joint. The value of these operations, the degree of their superiority over amputation, the grounds of choice between the two procedures, vary for each joint, and must be for each the subject of separate study.

Each extremity possesses three large joints, the first uniting it to the trunk (the scapula being reckoned therewith), the second in the middle, the third near the end of the limb. Amputation performed at the first joint removes the whole extremity, and proportionally less for the second and third ; hence is more objectionable the higher the joint which it is intended to remove. Moreover, amputation at the first joint does not take away the whole of the disease unless a portion, more or less, of the bone of the trunk be taken with it. The other joints are differently placed, and the surgeon must choose which of the two operations he may deem most conducive to his patient's benefit. There is no doubt as to which he would select, if he could be certain that while exposing life to no greater danger, he could, by the one, secure to his patient a useful limb, which by the other proceeding would be sacrificed ; both these points have now to be investigated. Excision may produce greater risk, and the limb retained may be useless ; the chances vary in each joint, and must be considered hereafter.

The general objections to amputation are—the risk to which the patient's life is exposed by the operation, for all amputations have a certain mortality, which *cæteris paribus* varies according to the proximity to the trunk at which the operation is performed ; or, perhaps, we might be nearer the truth by saying, according to the amount removed—thus, amputations at the thigh expose to greater danger, the higher the point at which the limb is cut off, and are more fatal than amputations below the knee—more dangerous than removal of the upper, which, again, is more dangerous than ablation of the forearm. The immediate dangers are from erysipelas, purulent infection, or the other sequelæ which are common to all operations ; but these may be increased by the severance of large vessels and nerves, which has of itself a peculiar depressing effect upon the system, and by the large loss of blood which sometimes attends such operations. Occasionally, moreover, patients sink after amputation without any obvious cause, and such effects may be attributable to the sudden removal of a large portion of the patient's body, together with a great quantity of his blood—all that the limb contained besides that actually effused. "It is also observed that patients who have suffered amputation for caries often fall into

bad health, and die of dropsy, or some other chronic complaint, within a year or two after the operation. These bad effects seem referable, with most probability, to the disturbance which is excited in the system by taking away a considerable portion of the body ; but whatever may be the true explanation of them, there can be no doubt as to the fact of their occurrence, which ought to be carefully remembered in making the comparison which is now attempted." [1] The last objection to amputation is the inconvenience which the loss of a member entails: an inconvenience which varies in each limb, according to the height at which the operation has been performed.

The advantages which are claimed for amputation of diseased joints are —its safety beyond excision ; the celerity with which the patient gets well ; the utter removal of the disease, which gives no further trouble. Of the safety of amputation something may be inferred from what we have said of its dangers ; statistical accounts for each amputation, as performed for disease, will be hereafter given. A patient who has suffered excision of a joint, particularly in the lower limb, must be, as a rule, kept in bed longer than one who has undergone amputation ; but it may well be doubted, as Mr. Butcher [2] has observed, whether he is able to bear the application of an instrument either to upper or lower extremity earlier than he would have been restored to use of the limb had it not been amputated. The utter and entire removal of the disease, which then ceases to give any trouble, is doubtless an advantage ; but is it so constant a result as is frequently affirmed, that amputation of a limb saves all further annoyance, except merely that of its absence ? We find in hospital a good many cases of conical stump, even after an apparently good operation ; there are also cases of painful stump, not conical, which appear to depend, as Mr. Hancock has shown, on a junction by some tough material between the nerve and the end of the bone.[3] In the beginning of 1860 a man was in Charing Cross Hospital, who had twice been amputated at the thigh, and died after amputation at the hip had been performed in a last attempt to save the fragile life.

The disadvantages urged against excision are : 1. Its greater danger than amputation. 2. The length of time required for cure. 3. The improbability of the limb being otherwise than an incumbrance. 4. The difficulty of selecting such cases as shall be not only saved, but have useful limbs. 5. The difficulty of the operation.

1st. In 1860, when the first edition of this work was printed, I ventured to throw very considerable doubt on the higher mortality of excisions, provided the operations were well performed and the after-treatment properly carried out. The *à priori* reasons for this doubt were thus given : The wound in most cases of excision is actually smaller, *i.e.*, the superficies of cut surface is less than after amputation at the same place ; moreover, by far the larger portions of such surfaces are brought again into contact with the parts wherewith they were formerly in continuity, and there is, in my mind, no doubt whatever, that healing takes place more readily under such

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[1] Syme On Excision of Diseased Joints, p. 16. I have thought it well to leave these remarks as they stood in my first edition. Surgery is still an advancing science, and the effects of antisepticism on the first-named source of danger—our better knowledge concerning lardaceous disease in eliminating the after-results mentioned by Mr. Syme —are not yet accurately ascertained.

[2] Dublin Quarterly Review, 1854.

[3] See Hancock on Painful Stump and on an Operation for its Cure, Lancet, vol. i., 1859.

circumstances, than when the wounded parts are brought into relation with strange surfaces. The large vessels and nerves of the limb are not implicated; no great portion of the body, solid or fluid, is removed; there is very insignificant bleeding, hence the shock should be less, and therefore the immediate danger less, than after amputation. The amount of more remote danger depends very much upon the after-treatment, the duration of the confinement, and certain other circumstances; chiefly on the absence of lardaceous degeneration of viscera. Nevertheless it is still asserted by some writers that excisions are more fatal than amputation at the segment above. For instance, Mr. Holmes:[1] "Excision is a more dangerous operation than amputation." Again,[2] "It is not very probable that excision of the knee will ever be less fatal than amputation. There is no conceivable reason why it should be so." On all these points I must differ from that distinguished author. I do so on the grounds of my own observation and practice; but, feeling this to be insufficient, I have collected much hospital experience—a course which appears to me incumbent on whomsoever would make assertions as to the mortality or comparative danger of frequently practised operations.

I have, therefore, taken six London Hospitals—namely, St. Bartholomew's, Charing Cross, St. George's, Guy's, Middlesex, and St. Thomas's—and from their published Reports of the last ten years I have collected the four amputations in continuity, and also the excisions of the four joints lying below the trunk. The excisions of hip and shoulder can hardly be judiciously compared with amputation at those joints, but they stand in a ratio of mortality highly favorable for the former, and only a little less so for the latter operation, although amputation at the shoulder bears a very low mortality. We have, then, to contrast excision of elbow with amputation at the arm; of the wrist with amputation at the forearm; and similarly with the lower extremity.

	Number of cases.	Number of deaths.	Percental mortality.
Excision of elbow	147	14	8.8
Amputation of arm	60	12	20.8
Excision of wrist	21	2	9.5
Amputation of forearm	65	7	10.77
Excision of knee	291	43	14.7
Amputation of thigh	474	121	25.5
Excision of ankle	47	6	12.6
Amputation of leg	175	31	17.7

These amputations, be it remarked, include no traumatic cases, otherwise the comparison would have been much more favorable to excision, even than shown in this table. Failure from causes other than death will be discussed in the sequel, and it is clear that a certain proportion of excisions have afterward to undergo amputation. This also is a subject for fu-

[1] Principles and Practice of Surgery, p. 943, second edition.
[2] System of Surgery, vol. v., p. 696.

ture remarks. My object just now is to correct a mistake which has been reiterated, which even I have not unfrequently contradicted at our societies —that the death-rate of excisions is higher than amputation, whereas, in truth, amputation of the arm for disease is nearly two and a half times as fatal as excision of the elbow. Pathological amputation of the thigh is not far from twice as dangerous to life as excision of the knee.

2d. The attainment of a good and useful limb, after excision, occupies a considerably longer period than does the healing of an amputation stump. In some cases such loss of time may be a serious consideration to the patient, socially and financially. In some it is surgically detrimental to him that he should long be confined to bed.[1] Hence this objection to excision is more potent, when we are dealing with a lower than with an upper limb, when we desire a synostosis, than when we aim at fibrous union. Again, a good deal must depend upon what, by the sacrifice of this time, or perhaps even by incurring this additional risk, the patient is going to save. A higher price may well be given for a useful, though somewhat feeble, arm and hand, than for a stiff knee and foot. Mechanical appliances, too, are better substitutes for the latter than for the former. Again, although the actual convalescence after amputation is shorter than after excision, yet the stump is for a long time, and sometimes for a very long time, incapable of supporting an artificial limb.

3d. There are a certain number of excisions which, without proving fatal, fall more or less short of their object, viz., the restoration of a useful limb. This failure may arise from various causes. 1. Soft, long, and insufficient union between the bones, giving rise to a flail-joint. 2. Synostosis where mobility is required. 3. Flexibility where rigidity is wanted. 4. Loss of muscular power. 5. Loss of growth in the limb. 6. Imperfect removal or recurrence of caries. The avoidance of these various disasters depends partly on the mode of operation, but chiefly upon the after-treatment; a great deal upon the quietude and docility of the patient, if synostosis be aimed at; and very much upon his courage and perseverance if mobility and muscular power be wanted.

4th. The difficulty of selecting cases that are likely to do well after excision, has been considerably exaggerated by some writers. The question, although it will be touched upon when considering special joints, may be here considered in its general bearings. It is evident that two points are concerned in the inquiry—the constitutional and the local condition. If it be true, as the foregoing statistics have shown, that excision of a joint is a less severe operation than pathological amputation above the articulation, it would seem, at first sight, that no state of constitution, which might permit the latter, could forbid the former. Indeed, as concerns the immediate effects of the operation, such deduction is perfectly correct; but if the process of repair be one that requires long confinement to bed, is likely to be followed by prolonged suppuration, more especially if the reparative material must, in order to leave a useful limb, be osseous, other considerations besides the mere immediate severity of the operation are involved. Firstly: Age. Resection of elbow or shoulder, but more especially of the former, may be performed at almost any age in which a disease amenable to such treatment is likely to occur. At these joints the uniting material is not to be bony, nor do they require to be particularly strong. On the other hand, one would avoid excising the knee or ankle of an aged individual. The ex-

[1] This consideration manifestly affects the choice of case, whereof something will be said in the sequel.

act period of life cannot be given in numbers, since some persons are, as far as health and condition of tissues are concerned, younger than others of the same years ; yet I think one may take the age of from thirty to thirty-five as about the limit beyond which one would not excise the knee or ankle. The condition of parts after an excision is simply like a compound fracture with very large wound ; and we know how much more frequent is non-union of such injuries at the latter periods of life.[1]

To judge with considerable certainty as to the state of health and constitution is very much a matter of experience and perception ; still some description of the materials for forming an opinion may be given. We have never, in the circumstances under consideration, to do with a person in sound and vigorous health ; but with one who has for some considerable time suffered from a wearing disease. The surgeon has to determine whether certain symptoms, denoting disturbance of health, hectic, exhaustion, etc., arise solely from the irritation of the joint disease or may not also be partly, perhaps even chiefly, due to visceral causes. Among the signs whereby the surgeon may arrive at this conclusion, is that the severe pain, occurring, as is usual, chiefly at night, is followed in the course of the day by a greater rebound from the morning's exhaustion than can be accounted for by the mere remittent character of hectic ; also, he, having watched his patient pretty closely, may observe that at some very uncertain times, ameliorations occur in the amount of such pain, and that they are followed by an immediate, almost instantaneous, improvement in the patient's condition ; there is, in fact, a *resiliency* in the constitution, which promises well for its recovery, when the irritating cause is removed. I need hardly add that pulmonary or other tubercule, must, especially in strumous cases, be sought for, and must, if found, forbid excision. The presence of even severe hectic in the absence of tubercle does by no means militate against resection, if the subject be young and possess that resiliency above described. On the other hand, if the patient have suffered prolonged and somewhat profuse suppuration, if under those circumstances evidence of lardaceous changes in either liver, kidney, or spleen be found, no excision should be attempted ; in such cases amputation is not only indicated but is urgently called for.

The local conditions precluding excision may be situated either in the soft or in the hard parts, or in both. It is doubtful whether any morbid state of the soft tissues should *per se* forbid resection. Certainly the condition which is named in this work, strumous synovitis, does not militate against the success of such operation, but I must repeat a strong opinion expressed in the first edition of this work, that a mere gelatiform condition —simply a redundancy of granulation-tissue in and around the joint structures, does not, of itself, call for, or justify so radical a proceeding. (See p. 98.) Abscesses extending even a long way among the more superficial soft parts (neighboring) do not contraindicate excision, if they be not too large, and have not destroyed too much tissue, or so situated that they may be well drained. But abscesses close to the bone or in the deepest intermuscular septa (adjacent) are more important, and unless small, *i.e.*, running but a little way up or down the limb, are considerable impediments to a good result.

The state of the bone is a point of greater gravity, but it is one which cannot, in the larger number of cases, be determined until, not merely their surface, but their cancellar structure is exposed, when the surgeon

[1] I purposely omit to mention here the hip. That joint is peculiarly situated, and its operative treatment must be taken alone.

having commenced his operation as for excision, may, if he see fit, conclude it by amputation. In a preceding chapter (Chapter XI.) an account was given of the appearances assumed by the cancellous structure of bone, under the influence of a strumous ostitis, and the distinction between a diffuse and a circumscribed inflammation was insisted upon, as the result of a marked difference, in the amount of constitutional cachexia, whereby the disease was produced. For our present purpose, it is of no importance whether the disease commenced in the synovial membrane or in the hard parts; we now have only to do with the appearances of the bone-section. These may deviate from the norm by hyperæmia, extravasation, granulation, suppuration, and by wasting or induration of the cancellar walls. This last appearance is in all instances favorable to excision, in direct proportion to the amount of tissue thus hardened, in contrast to the amount which has undergone softening; it is a sign of a condition of parts capable of formative actions; such condition is very rarely spread over the whole section-surface, and then only in the rheumatic form of inflammation. In strumous cases, induration of the bone-tissue, when present, alternates with softened portions, and the more of the thickened tissue be found upon section, the more favorable is the case. Other appearances, hyperæmia, granulation, suppuration and wasting of the cancellar walls, will all be present in cases of strumous disease so far advanced as to justify operative interference; none of these should of themselves militate against completing the excision; but if they be diffused over the whole, or nearly the whole section, be hardly at all intermingled with indurated portions, and not confined to one or two spots surrounded by thickened osseous tissue, it will be better to amputate the limb.[1] A diffuse inflammation, wherever it be situated, and whatever be its products, always marks so low a constitutional state, that we should give the system as little reparative labor as possible; the granulation produced by such an inflammatory act will hardly form the sound tissue so essential to success in these cases, but will greatly tend to the degenerative processes. The more straw-colored be this tissue, the less should we trust to its organizing force. Again, if the section-surface be throughout of a dirty yellow, from diffuse suppuration, and the cancellar walls be all softened, impressible with the finger, or incisable with the knife, amputation should be at once employed. Extravasations in a few small specks do not, but large blotches of extravasated blood should forbid excision. Tuberculous matter, when present, is a decisive call for amputation; but we have already questioned, if the material which in bone is often called tubercle be in reality that morbid tissue, although we cannot deny that such may in a few rare cases exist.

If such appearances be limited to circumscribed portions of the section-surface, there is still a further investigation to be made, namely, the depth to which the softening extends. Unless the superficies of such a portion be very soft, it is hardly likely to extend far; the gouge, or Mr. Marshall's osteotrite, may be used, and the diseased portions removed; but if they run a long way into the bone, more especially if, as sometimes happens, the several spots unite, and form a large area of softened tissue some way from the surface, the case is not suitable for excision. Again, if there be a sinus-like hollow, only filled by granulation-tissue, running far into the osseous structure,[2] in such way that removal of the surrounding carious bone leaves

[1] A worse condition of parts may be tolerated in the upper limbs, where synostosis is not desired.

[2] The meaning of the word *far*, varying for each joint and bone, must be left to the judgment of the operator.

a large cavity, the limb had better be amputated. The patient may perhaps do well, even get about, but I have had occasion to observe that abscess in the bone is afterward produced. In one case of this sort, the man has told me that he suffers so much at different times, as often to wish his leg had been removed. It may be well to place in a succint form the conditions which do not, and those which do, contraindicate excision of a joint.

Conditions Unfavorable to Excision of a Joint.	Conditions Favorable to Excision of a Joint.
General.	
Coexistence of any internal organic disease, chiefly tubercles of the lung or mesentery. Albuminuria, lardaceous enlargement of the liver or spleen, simultaneous affection of any other important joint or of the spine.	Absence of all internal disease; or of simultaneous affection of other important joints, or of the spine.
Apparent dependence of hectic fever upon some cause other than the local disease.	Dependence of hectic fever solely upon local disease.
Local Condition of the Soft Parts.	
Adjacent abscesses extending a great way from the original seat of disease,[1] more especially if running upward from the affected joint.	Restriction of morbid change to a locality not far from the original seat of disease.[1]
The more rapid and profuse the suppuration, the less favorable is the case.	The more chronic and the less in amount be the suppuration, the more favorable is the case.
Local State of the Bone.	
Prior to commencement of operation.—External caries or suppuration of the periosteum extending a considerable distance from the joint-end; whether this be primary or produced by spreading of the inflammation.	*Prior to commencement of operation.*—Restriction of morbid action to a locality not far removed from the joint-end.
After removal of a slice of bone.—Presence of extravasations, particularly if multiple and in large blotches.	*After removal of a slice of bone.*—Absence of extravasations, or their appearance only in a few small spots.
Diffusiveness of inflammation, more particularly if it be suppurative.	Circumscription of the inflammation, whether suppurative or no.
Absence of all bony thickening; presence of diffuse softening.	Presence of bony thickening, more particularly if it be not scattered, but either total or circumscribing any softening, or other low form of inflammation that may affect the bone.
Softening of the whole, or nearly the whole. section-surface, particularly if combined with diffuse suppuration, or if the granulation-tissue be straw-colored or greenish.	Absence of great amount of softening, or suppuration; florid, healthy granulations, circumscribed by indurated tissue.

[1] This indication, or contraindication, is but a question of degree and direction; for instance, abscesses *down* the thigh, in hip-joint disease, do not, but abscess far *up* the thigh, in knee-joint disease, does forbid excision of the joint.

5th. There remains only the last of the objections which have been urged against excision, namely, the difficulty of the operation. This, at the present day, will hardly have weight; the surgeon has no right to substitute for an arduous operation an easier one, which may be less advantageous to his patient. Moreover, the difficulty of excision is not sufficiently greater than that of amputation to deserve consideration; indeed, the operations at any joint, save perhaps the wrist and ankle, are far from difficult.

The various circumstances now detailed having been duly weighed, one against the other, the surgeon will make up his mind according to the balance of facts. If he be led to amputate, the joint disease, indeed all circumstances having special reference to the present subject, are done away with. But if the surgeon excise the joint, many matters of great interest for our subject arise, and we will examine them accordingly.

C.—*On some Points to be generally Observed on Excising Joints.*—Repetition will be avoided if a few points, to be observed in the excision of all joints, be insisted upon before considering special cases. In the first place, the operation should always be so performed as to do as little injury as possible to the soft parts, and so as to avoid any important nerve or vessel. The incisions should always[1] be so devised that some part of the external wound is depending, allowing a free exit for pus. So important in my mind is this condition, that ease of operation, or even small size of incision, may be readily sacrificed for a *depending opening;* or in certain cases a special opening, or drain, independent of the operation-wound, may be made. Whenever it is desirable that the bone removed in the operation should be reproduced wholly or in part, the subperiosteal method should be employed, and this is more especially valuable at the shoulder, the elbow, and generally at the hip. After excising the knee and ankle, two flat surfaces are placed in contact in order to produce bony union. Any periosteum projecting around or hanging in folds about this junction is of no use, and if it generate new bone can only do so in the form of irregular osteophytes or a rough ring. It is true that in excision of the ankle the ablated fibula might be reproduced; but this, since the tibia and astragalus become or ought to become indissolubly united, is valueless. The advantages, beyond regeneration of bone, claimed for the subperiosteal method, are—that the muscular attachments, being peeled off with that membrane, are preserved; that the elevator, passing beneath it, does not wound or injure the articular plexus; and that not only is less bleeding produced, but that subsequent nutrition is less impaired. It is to be remarked that although there is great difficulty in paring the periosteum from a healthy bone, there is usually no difficulty in detaching it from one which is inflamed, since the deeper vascular coat becomes puffy and soft, while the fibrous coat, easily torn in health, is rendered flexible and tough.

Partial excisions, except at the hip and shoulder, are undesirable. I do not mean by this term the mere removal of sequestra or splinters, but such an operation as in gravity and form resembles ordinary excision, and only differs by the omission to remove certain parts, as for instance, after taking away the condyles of the femur to leave the tibia intact.[2] It is true that here and there a joint so treated will get well, but the greater number of such cases end in disappointment.

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[1] Civil surgery has generally the choice of locality in making incisions; in military surgery the knife must frequently be guided by the bullet.

[2] Under certain circumstances, and when one side of the elbow-joint remains sound, one may leave the head of the radius *in situ*.

The epiphysal ends of bones are in early life separated from the shaft by a line of cartilage, an arrangement which permits growth in length by the constant addition of fresh bone to the end of the diaphysis. It is evident, from this fact, that if in a person who has not yet attained full vigor, the epiphysal end and cartilage be altogether removed, the bone ceases to grow; such defect is more important in a lower than in an upper limb. Hence, the younger and smaller the child upon whom we have to operate, the more care must be used not to cut off this portion. It will subsequently be mentioned, with regard to two joints, that in one the epiphysis is less, in the other more, important than elsewhere.

It is of the greatest importance that, after a resection, particularly of a large joint, the limb should be adjusted with as little irritation to the patient as possible, not merely for the sake of saving pain, but in order that the wound may be adjusted at all. In some parts this is of less, in others of more, consequence; but in all it is sufficiently important to deserve the strictest attention, and, in the knee more especially, may make all the difference between life and death. Hence, unless peculiar circumstances forbid, narcosis should be continued until everything is arranged.

On the Reparative Process after Resection.—It is not necessary to linger long over this part of our subject, because the minute differences in the various modes of repair are of but little practical importance, and because Wagner's exhaustive treatise on the subject, having been carefully translated by Mr. T. Holmes for the New Sydenham Society, is within reach of all. The experiments upon animals, made by Wagner, and the number of cases of post-mortem examination which the author has collected, and which has been admirably completed by the translator, give plentiful examples of the local conditions after excision. Immediately after the operation there is set up an inflammation, which causes all the parts around to swell.[1] In a certain time, which varies from two to five days, pus begins to form, and at the same time granulations arise. In cases where the spongy texture of bone is cut through, as in resections of large joints is always the case, those growths arise probably as early from the cancelli as from the soft parts surrounding the bone. At least in one case in which I had an opportunity of examining the condition of a small portion of surface a few days after excision, I found it covered with small, florid, velvety granulations. The result of this action, both in hard and soft parts, is the following: the ends of the bone become enclosed in a bag of granulations, which separate them from surrounding parts, and act as a bond of union between them.[2] When the osseous extremities lie close together, the granulations which spring from them occupy the narrow space. When there is a more appreciable interval between the sawn surfaces, those growths often do not sprout quickly enough to fill up the cavity. Those from the soft parts being more luxuriant, take upon themselves that duty, and thus the bag forms within itself a partition, which divides it into two portions, each containing a fragment of the bone.

In the first case the granulations from the cut end of the bone may unite, forming at first a soft bond, which may become fibrous, and ultimately

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[1] The great extravasations of blood, and the distention of tissues which Wagner describes as a phenomenon always present in animals, whether bones be resected or merely broken, is not either a necessary or a frequent sequela of resection in the human subject.

[2] This enclosure of the ends of bone by a membranous bag must not be considered as an action peculiar to either fracture or resection (for it occurs in both); it simply results from irritation of the surrounding parts by the ends of the bone, or by surgical disturbance, and is analogous to the encysting of a bullet or other foreign substance.

osseous. Even the inner layers of the surrounding granulations, having become united to the periosteum, may ossify, forming a provisional callus. Or the new growths from the bone cancelli may not have the power to produce new tissue; the bones will not unite; but their ends are gradually rounded off. The capsule produced by the granulation from the soft parts becomes fibrous, and thus a false joint is formed, the ends of the bone becoming polished by attrition, when movement is allowed; or, if cachexia remain, they may again yield to caries.

In the third event, that in which the granulating bag of the soft parts sends a process between the bones, this partition may become united to the granulations from the cancelli. Thus, also, a fibrous junction is formed; but under those circumstances the bond of union hardly becomes ossified. More usually, the new tissue from the bones does not unite with this interposed material, but, while the osseous ends become rounded off, that production assumes a fibrous and, when motion is allowed, even a fibro-cartilaginous structure. By this means a condition is produced, most frequently met with at the shoulder, wherein each bone is enclosed in a separate cavity, being bound together by the circumference, and separated from each other by the partition in the bag. The whole is comparable to the joint of the jaw, wherein the joint-surfaces are separated by a fibro-cartilaginous meniscus.

In all cases, when a pseudo-arthrosis is formed, the inside of the bag becomes lined by pavement epithelium, secreting a glairy, synovia-like fluid; but synovial fringes, or villi, seem not to be produced. Sometimes, in such instances, the extremities of the bones become covered by an ill-developed cartilage. When the osseous ends at the shoulder-joint are separated from each other by a considerable interval, it may happen that a thin styloid process is developed from the humerus to articulate with the glenoid cavity, which in all the cases in which this arrangement has been found was not cut away.

It follows from these facts that, in order to secure a firm union, the extremities of the bones should be kept close (not pressing) together. If this union is not to be bony, passive motion must after a time, depending on the more or less tough bond already formed, be instituted. Perfect immobility must be enforced if osseous union is to result. If, on the other hand, free mobility, rather than strength of the new joint, be desired (as at the shoulder), the osseous extremities need not be kept very close together.

Any definite idea, anything beyond a vague personal impression, as to the relative frequency of fatal, bad, and good results, can only be obtained by statistic numbers;[1] and I should be very glad could I give for each joint the results of excisions. I have tried to gather them from the Reports of certain London hospitals; but must acknowledge that the tables do not attempt to specify ultimate results sufficiently closely to be used. Moreover, a certain number of patients are discharged from the hospital with good limbs, promising to be better; but either from neglect, insufficient food, drunkenness or other cause, the part does not improve, and after a few months or years the saved limb is useless; an elbow which had good motion has been allowed to get stiff, or a knee which was firmly synostosed

[1] A wonderful statistic gathering of the results of excisions in military surgery has been made by my friend Dr. Gurlt; and an equally valuable, though as yet uncompleted work, has been carried on by Dr. Otis regarding the American war. The labor of these works must have been enormous. I shall use their numbers freely when desirable, but the conditions of traumatic and pathologic excisions are quite dissimilar.

has got loose or bends. These after-failures must often be ascribed to some fault of the patient, not of the operation. For instance:

Case LXXXIX.—I excised the knee of a lad in 1874. He made a good and speedy recovery, and in the same year was dismissed, walking with a good gait down the steps out of the hospital. I saw the boy from time to time, his mother often begging me to order him not to be so rough in his play. In the early part of 1879 she asked me to take him in again, as he had met with an accident. When I saw him he told me that three weeks previously one of the boys with whom he was playing leap-frog rose at the moment of his leap, throwing him violently to the ground; he both heard and felt the bone crack, but for fear of a scolding said nothing about it, until the pain and swelling forced him to do so. I found a large abscess about the place of incision—necrosis of a large portion of the femur—and I amputated at the thigh. The boy got quickly well.

Each joint has (setting aside injury), after excision, certain functions to perform, certain actions to go through, which may even after the lapse of years gradually impair or improve the condition of limb, by rendering the joint firmer or looser, as the case may be.

The surgeon should therefore know the tendencies of the union at different parts. The shoulder is, if the junction be freely movable at the time of dismissal from care, very liable to become after a year or more too loose; especially is this the case, if the elbow remain feeble—the weight of the arm, hanging almost entirely on the new ligamentous bond, stretches it and relaxes its fibres. So also at the elbow, if an almost perfect reproduction of trochlea and olecranon have not occurred, and if a few months after excision the union permit of perfectly free motion, there will in all probability be a flail-joint in a year or two. At the wrist the common fault is more and more restricted mobility, but what mobility there is at the fingers usually increases with time, if the patient be courageous and persevering. The union at the hip generally gets stronger with time. That at the knee, if the patient walk before the junction is quite firm, bends outward (bow-leg), sometimes forward; the slightest deviation must be watched for and guarded against. Increasing shortness of limb after excisions in the lower limb is a serious drawback—it is most marked after knee-exsection. No change, as far as I am aware, takes place at the junction between tibia and astragalus if it be good at the first; but the tarsal joints increase in flexibility, so as to more and more compensate for loss of movement at the ankle.

All excisions should be performed antiseptically; if sinuses and open abscesses already exist, these should, for some days before, be washed out and syringed twice in the twenty-four hours with a three-per-cent. solution of carbolic acid; if they involve much tissue, parenchymatous injection of 2.25 to 2.5 per cent. solution may be used with advantage in the neighborhood of the openings and about their track. I have been careful in collating the statistics of operations; but I am confident that these will be immensely modified by the employment of full antiseptic precautions. Such belief is irresistible when one sees case after case of excision of large joints get well, without a rise in temperature or an uncomfortable symptom.

Special.—On the Resection of Individual Joints.—*The Shoulder.*—As with the hip, so also at the shoulder, the operation usually performed is termed an excision of the joint although decapitation of the femur and of

the humerus respectively would be the more correct term, because those bones only are generally subjected to the saw. As we shall see hereafter, the socket may at either part also be removed. In civil practice the operation bears but a low mortality, as gathered from six London hospitals for ten years, viz., 22.2 per cent., but the number of cases thus treated, amounting only to eighteen, is very small, smaller than that of any other excision.

In military surgery it is the more frequent of all joint-excisions. Thus, Gurlt [1] gives as the number of cases in all the German wars from 1848 to 1871 inclusive, 568 cases, of which 357 were cured, 203 died, 8 unknown; a mortality of 36.25 per cent. Otis [2] gives 885 cases, of which 571 cured, 9 unknown, 305 deaths, a mortality of 34.82 per cent.; or, if we add the results in German and American wars, we get a total of 1,433 cases, 928 cures, and 508 deaths; 17 cases being untraceable,[3] the death-rate being 35.37 per cent., which will be seen, when we speak of other excisions practised in war-time, to be very small.

Several modes of excising the shoulder-joint have been practised and advocated. White removed the head of the bone by means of a single longitudinal incision. Moreau [4] made use of an old incision in front of the joint, drew another at the back, united them above by a third, and turned down the quadrilateral flap. Such a method exposes the joint much more, and makes a larger wound than necessary. Syme [5] proposes a longitudinal incision from the acromion on the outer side through the middle of the deltoid to its insertion, and another from the lower end of this, backward and upward to the posterior border of the axilla. Liston proposes "an incision three inches long, running from the point of the acromion through and near to the insertion of the deltoid, or, what is much better, may course along the posterior border of that muscle. More room is gained for the completion of this operation by making an incision from the front of the acromion three inches down the arm across the chest, and raising the elbow, the head of the humerus protruded and examined, and so much as is in an unsound condition taken away with the saw." [6] Langenbeck operated by means of a deep cut in front of the joint, running from the acromion process downward. He then released the tendon of the biceps from its groove and turned it inward; by rotating the humerus first outward, then inward, the capsular muscles were brought into view and divided; then the elbow being thrown back caused the head of the bone to protrude at the wound. This operation is not only easy but artistic in all its steps: it has, however, this fault, that it allows no outfall for pus. Stromeyer adopted another mode of incising the integuments: beginning at the outer and back part of the acromion, he makes a semilunar cut with the concavity forward, opening the joint above and behind; the rounded flap being lifted and the arm rotated outward, the biceps tendon can be turned out of its groove inward and preserved.

Certainly it is desirable in every operation to save all parts whose severance is unnecessary, but it may be remarked that division of the long head of the biceps does not seem to produce any diminution of power. In three

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[1] Die Resectionen nach Schupverletzungen, p. 1216 et seq.

[2] Surgical History of the American Civil War, p. 655.

[3] Otis and Gurlt make careful subdivisions as to primary, intermediary, and secondary operations—the former more especially subdivides the cases according to the amount of bone removed. These details, most useful in a record such as theirs, would be valueless in a work on joint disease.

[4] Observations pratiques relatives à la resection des articulations, etc., p. 80.

[5] On Excision of Diseased Joints, p. 50.

[6] Practical Surgery, p. 159.

cases by Esmarch [1] this tendon had been divided by the bullet: perfect use of the muscle was restored. Moreover, an advanced disease of the shoulder-joint affects the whole of the capsule, and involving the upper part of the tendon in the inflammation, destroys it. If the glenoid process be cut off the attachment of the long bicipital head must go with it. It is otherwise with the circumflex nerve, which can almost always be preserved.

I greatly prefer the operation by a single incision; it gives room enough in all but a few cases of exceptional swelling about the head of the bone, and even then a slight modification suffices. The following is the method which I recommend: choose a place on the acromion a little in front of its outermost point, and begin the incision *on the upper surface* of the process, otherwise the deltoid, which here arises not so much from the bone as from a sort of ligamentous tissue, covering it cannot be separated enough to afford sufficient space; carry this incision deeply through the muscle to about an inch or an inch and a half from its insertion, take care that the course of the knife be exactly along the muscular fibres so as to avoid dividing any of them; over the neck of the bone do not sink the knife quite as deeply as elsewhere, so as to spare the nerve. If the incision be, as is most probable, not deep enough over the joint, put the left forefinger in the wound and feel for a rolling cord running across the bone; it is the circumflex nerve, which, unless there be much thickening about the neck of the humerus, can always be detected; keep the left index on this nerve, or on its situation, above it introduce the blade edge upward, run it along to the acromion, deepening the incision by cutting skinward. The nerve is often sufficiently isolated to be hooked down to the lower part of the incision with an aneurism needle; if not, a few cautious touches of the knife, guided by the exploring left index, will loosen it, and if the subperiosteal mode be not followed, the nerve must be held down by the assistant. The long head of the biceps may then be sought, which, if it have not been absorbed by the disease, can easily be extracted from its groove and turned inward. Now the arm must be strongly rotated outward, and the subscapular tendon separated from its attachment, the blade being kept close to the bone, the handle inclined forward. Afterward the arm is rotated inward, the supra, infra spinatus, and teres minor divided. The capsule of the joint has probably been already opened, but that opening must now be enlarged transversely, giving ample room for the head of the bone to pass out. After this the knife is to be laid aside, the surgeon grasps the elbow in one hand, places a finger of the other in the joint, hooking it over the caput humeri, and partly by pressing with the former, partly by guiding and drawing with the latter, extrudes the bone, and removes as much as may be necessary.

This description applies to cases which present no difficulty; but certain conditions may considerably interfere with, or render impossible, the completion of an operation in this way. There may be so much swelling about the joint that a simple straight incision gives no room for the after procedure. If this occur, do not cut the muscular fibres, but simply make, *on the upper surface* of the acromion, near to and parallel with its outer margin, a curved incision across the upper end of the primary one, detach the muscle or rather the fibrous expansion it springs from, and thus a triangular flap may be turned both forward and backward, affording ample space.[2]

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[1] Ueber Resectionen nach Schusswunden.

[2] I wish to lay peculiar stress upon this mode of enlarging the incision, as the character of the deltoid origin appears to be ignored or is not utilized.

Another difficulty often met with is this: the disease may have so thickened the capsule and surrounding parts, or may have produced such muscular contracture, that the arm cannot be rotated far enough to let the surgeon divide the scapular muscles. In that case he can first incise the capsule transversely, pass his finger into the joint, hook it over the head of the bone, and draw it a little out; then pass the knife into the joint in front of his finger, inclining the handle forward, and bringing the blade close to the bone, cut in the downward direction (arm rotated as far as possible outward) beyond the lower margin of the lesser tuberosity—he may then do the same behind his finger. In this procedure a blade curved on the flat is useful. By following these directions no considerable difficulty will be met with, and the power of the deltoid will be, if not entirely, at least very considerably preserved. But we have now, for drainage in the recumbent posture, no depending opening; this may be secured by passing a seton needle or a bistoury and armed probe from the cavity backward through the skin, avoiding of course the circumflex nerve, and with the thread drawing a drainage-tube into the gap.

It happens, I think, more commonly at the humerus than elsewhere, that a considerable quantity of bone requires removal, and the probability of such necessity can, previous to operation, only be surmised, hence at this joint subperiosteal excision is peculiarly applicable; the steps, up to the time when the bone is exposed, are precisely like those already described. The bicipital groove is then taken as the guide, and the surgeon carefully avoiding injury to the tendon, if it still be present, draws the knife along the anterior ridge upward to the glenoid cavity, making a simple straight cut, liberating the tendon which is to be drawn to the inner side. The elevator must now be insinuated into this cut, and the periosteum peeled carefully away from the front and inside of the bone, while the limb is being rotated outward—with the membrane, the subscapular insertion must be pared away—it may be, that for this and the other muscles the knife must be used, not to divide the muscle, but being kept flat on the bone, to lift it off that structure. When this is completed, the arm is brought back to its original position, and the membrane outside and behind the bicipital ridge, together with the muscles, is peeled away while the limb is rotated inward. The surgeon must not allow the elevator to slip, and he is not to be discouraged by finding that these rotation movements are at first very restricted. As he goes on shelling off the membrane, and with it the muscles, he will find that the limb can be turned more and more, so that indeed the inside of the bone will come at last to lie pretty nearly under the wound, and when nearly all the circumference of the neck and tuberosities has been cleared, the bone, whose head is protruded through a rent in the capsule, comes out from the rest of the membrane like a twig of green alder from its bark. In young subjects it may happen that the tuberosities come off from the shaft with the periosteum and muscular insertions; but when the new osseous tissue forms, they became included in and united with it, thus giving fresh attachment to the muscles.

Besides joint diseases, complicated fracture, or irreducible dislocation, may necessitate resection of the shoulder. Fracture at or near the anatomical neck is frequently combined with displacement of the lower fragment generally forward, less often downward, simulating subcoracoid and subglenoid dislocation respectively. As a rule, reduction is easy, but retention of the bone in its place is frequently impossible (the detached head is generally twisted round in the socket). We know that after a time a new glenoid cavity is generally formed by bone thrown out from the venter of the

scapula, or by the lower surface of the acromion generally in conjunction with the coracoid. Of this there are several specimens in the Charing Cross Hospital, as also in the College of Surgeons Museum,[1] and if conclusions were drawn from the dry bones alone, one might believe that an excellent substitute for the normal joint was formed; but an acquaintance with the life history of such cases shows, that although at first the hand and elbow are mobile and free, yet afterward a slowly advancing paralysis sets in, which appears to affect the extensors of the hand; if the displacement be subcoracoid, the flexors; if it be axillary, the fingers becoming very immobile and claw-like. The approach of such condition is a potent indication for resection, which, by removing the pressure on the axillary plexus, cures paralyses thus produced, if they be not too old, even though, as is usually the case, the truncated bone has a great tendency forward.

The after-treatment of this excision must, in great part, be regulated by the manifest tendency of the limb to greater laxity or greater stiffness, and also by the amount of the humerus removed. When a considerable length of that bone has been extracted, passive movement should not begin too soon. If only the head and a small part of the neck have been resected, it may, if the wound have healed or be healing well, commence in three weeks, but must not, in view of the usual tendency to too great laxity, be carried too far. The position, in which during repose I prefer from the first to place the limb, is at right angles to the body and directly lateral.

Case XC.—Mr. J. B., aged twenty-eight, came to me from one of our largest colonies April 4, 1871, suffering from disease of the left shoulder, apparently due to exposure after slight traumatism, which occurred in 1868, since which his shoulder has been painful and lame.

At the time I saw him the arm, especially the upper arm and deltoid, were much wasted; the limb was kept useless at the side, nor could it be abducted without much pain; it still permitted of rotation to a slight degree—he could bend the elbow and use the hand, though he could neither quite flex nor straighten the fingers. The head of the humerus was enlarged; pressure on it caused pain. There were two open sinus-mouths, one in front, about two and a half inches from the acromion; the other at the outer side a good deal lower down. A probe passed into either of these openings impinged on rough bare bone. Three old depressed scars existed. He suffered frequent pain, chiefly at night, and his arm, he said, was never easy, he having a constant numb, vague, tingling sensation about the hand and forearm. He said that the voyage had greatly improved him; he had less pain than before starting, and had gained a little in weight.

April 10th.—Having explained the condition of the bone, he permitted me to make an exploratory incision, which I did over the front of the arm, a little outside the cephalic vein, including the anterior of the two sinus-mouths. My probe and finger detected new periosteal bone all around, perforated by several cloaca mouths, and inside a sequestrum, which did not appear to be loose.

April 12th.—He consented to removal of the necrosed head of the bone, but wished a week's interval for some business.

April 19th.—Renewing and slightly extending the incision, I was able to take advantage of some cloaca openings, and with small bone-forceps, and raspatory to turn aside, without removing the periosteal bone for an inch below the tuberosities; all this part of the humerus was dead, very rough, and

[1] Pathological Series, No. 3273, 3273A–3276.

here and there excavated. About this distance below was a rather deep line running all round, except at the back, where the bone was still living. I passed a chain-saw round at this spot, detached the necrosed head, and then, without much difficulty, drew it out of its new case and the wound. My assistant making traction on the arm, I found the upper and front part of the glenoid cavity necrosed, and introduced a gouge—fortunately at the exact line between living and dead—when I was pleased to find the sequestrum detach itself quite easily. The new bone with the periosteum was now replaced in its normal position, and preferring to make no posterior opening, I elected to trust to frequent syringing (as I had an excellent nurse), dressed the part very lightly, placing the whole limb on a balance-swing.

April 20th.—He suffered very little pain, but had $\frac{1}{3}$ grain of morphia subcutaneously last night, and slept very well; in the morning was sick once or twice.

April 24th.—Wound been dressed twice; looking very healthy.

May 8th.—Has gone on uninterruptedly well. Wound too great a tendency to heal. Passed in drainage-tube; discharge about $1\frac{1}{2}$ drachm per day.

May 22d.—Hardly any discharge. Began passive movement, as shoulder seemed inclined to stiffen.

June 10th.—Arm freer in passive motion; was very pleased to find he had some power in lifting it from side; fingers recovering their power, both of flexion and extension. Ordered him to sit sideways on a chair with back of fitting height, to place a folded handkerchief in axilla, and hang the arm from corner of back-rail, attach one-pound weight to wrist, and swing arm in every direction, chiefly in abduction.

June 30th.—Wanting to go back, the arm having gained greatly in power, but a sinus-mouth still open at lower end of operation-wound.

July 26th.—Took leave of him. He had a very good arm; shoulder a little inclined to be stiff, but constantly gaining in mobility. Has complete power over elbow, except that he cannot quite straighten it. Hand movements perfect, with pretty firm grasp; but the limb is not so strong as that of the other side.

The following history records, I believe, the youngest case in which excision of the shoulder has ever been performed.

Case XCI.—Jane L., aged nineteen months, was brought to me February 6, 1863, suffering from acute disease of the right shoulder-joint, supposed to have been caused by a fall.

The shoulder was greatly swollen; the skin showed a distinct blush, was hot and dry. The child evidently suffered severe pain, and was in a high fever. The arm was tied to the side, and the case treated as one of acute ostitis.

February 12th.—The shoulder still more swollen and red; fluctuating. The child lay in an apathetic state, except occasionally, when it screamed for some minutes, and then sank again into apathy. I made an incision through the front of the deltoid downward, large enough to admit my finger; about two ounces of pus escaped; I found the upper part of the humerus bare and rough; enlarged the opening both upward and downward, and with a raspatory turned back with great ease the already loosened periosteum all round the humerus, taking the elbow in my left hand, and hooking the right forefinger over the head of the bone, I guided this latter out of the incision, and removed the head and a small piece of the diaphysis with a saw. The

section surface, however, showed considerable disease, and I took off rather more than half an inch of bone farther down the shaft; two small vessels were ligatured and several twisted; the scalpel was thrust through the integuments behind, and a drainage-tube introduced. The cavity was mopped out with De Morgan's chloride of zinc solution, and the wound sewn up close.

February 14th.—The child was, during the first six hours, much exhausted by the operation, then rallied, and afterward was much better and easier than before. The redness had quite disappeared, and the swelling was much less. A piece of stout leather was bent at an acute angle, which fitted into the axilla, one portion supporting the arm, the other, rather broader, resting against the side.

February 18th.—The wound looked very healthy; the child had lost the pyrexia and the swelling had almost disappeared. Very little discharge; drainage-tube removed; but wound to be syringed out daily with permanganate of potash.

February 25th.—The wound nearly healed; the child appeared to suffer very little indeed.

March 3d.—Wound healed, except a small part near lower end, which wept a little thin sero-purulent fluid.

March 7th.—The mother took the child away, promising to bring it weekly.

March 31st.—Passive movement having been employed for a week, the child was able to move the arm below the elbow, and could, in order to reach a bit of sugar, advance the elbow somewhat, but could not lift it away from the side laterally.

April 28th.—The child was at this time in good health, and running about freely. The forearm and hand were perfect in their movements; the elbow could be advanced but not drawn back; a little power to raise it laterally seemed returning.

June 30th.—Much more power in the arm; she could now lift it a little over four inches from the side—it measured from the acromion ¼ inch shorter than the other. A certain amount of fresh bone had formed, and this at the proximal end was spread out and enlarged somewhat; it was in contact with the glenoid cavity, but on moving the arm it slipped in different directions, downward more especially in raising the elbow from the side. I attributed the weakness of such movement to this instability, rather than to weakness of the deltoid, which, indeed, was but little wasted. I had the arm bound to the side, prohibiting its use for two months, lest the joint should get too loose.

October 28th.—The bandages were discontinued. At the end of September the joint was much firmer; passive and active movement had been continued for five weeks, and she had at this date a useful though rather a weak arm.

January 19, 1868.—I had seen this child from time to time. The arm continued good; but in the winter of 1866–67 she developed symptoms of phthisis, after a rather severe attack of pneumonia; at above date she was very ill, being nearly seven years old.

I heard of this child's death three weeks after the occurrence on April 17th—too late to procure a post-mortem examination.

Excision of the Elbow-Joint.—Mr. Syme claims, with perfect justice, the introduction of this operation into England. Mr. Park had practised it on the dead, but never on the living subject. Moreau père et fils performed it

several times, and with admirable success. Mr. Syme's excision was performed in 1828. The patient does not seem to have been a good subject for operation, and did not regain much command over the elbow—but "he is able use it," says Mr. Syme, "in giving instructions in arithmetic, etc." Other cases of the same surgeon were more completely successful.

The proportion of deaths is in these cases very small. The sources whence I have gathered my statistics give a percental of 8.89. Gurlt, for the German wars, gives a total of 708 cases, of which 517 cured, 15 unknown, 176 deaths, a mortality of 25.39 per cent. Otis records a total of 626, with 470 cures, 10 unknown, 146 deaths ; viz., 23.7 per cent. of deaths. By addition we obtain a grand total of 1,334 cases ; 987 recoveries, 25 unknown results, and 322 deaths—a general mortality of 24.59 per cent.[1]

The methods of operating are many. Moreau's H-shaped incision is now almost obsolete, having been supplanted by a simple straight cut along the inner aspect of the back of the arm. If the parts be so swollen that more room is wanted, a second short incision, running from the first one across the olecranon to the outer condyle, may be added ; if still more room be required, the outer limb of the H can afterward be added, but it is rarely wanted. Through this incision either an open or subperiosteal resection can be practised. I will describe first the former. The first incision should begin behind the humerus, about two inches above the inner margin of the olecranon, and pass downward along the edge of that process, and two inches along the subcutaneous surface of the ulna. The knife is to be guided by this bone, and is not to sink into the fossa on its inner side. Now all parts inside this wound are to be peeled from the bone. It is indifferent whether one begins on the ulna or on the humerus ; the important thing is to *keep the knife close to the bone,* more especially when dealing with the groove behind the epicondyle. By following these directions, the ulnar nerve will be thrown inward with the whole thickness of the soft parts, and ought never to be seen at all ; but the innermost tip of the condyle must be brought well into view. Now, the parts outside the long wound are to be turned aside, the muscles in the interosseous space, and even the fascia over them, are to be spared ; but the capitellum radii and the outer condyle must be bared : arrived, supposing the dissection proceeds upward, at the tip of the olecranon, the blade is to sink deeper, and turn the triceps up with the skin, detaching it, as has been already done, at the inner flap, from its insertion. Now the knife is to sweep from above downward along the inner edge of the great sigmoid notch, entirely dividing the internal, then it is carried between the head of the radius and rotula, severing the external lateral ligament. The assistant now bends the joint, so that the wrist lies in contact with the higher parts of the arm, the thicker muscles in whose middle then form a fulcrum, lifting the ulna, to which the head of the rachus is still attached, away from the trochlea, exposing all the joint-surfaces, from which as much as may be necessary is removed. I always endeavor, even if the capitellum of the radius be diseased, to leave it attached to the ulna. One may gouge it or take away half its thickness without destroying this connection ; but if the disease involve the bone lower down, the whole must be

[1] These numbers are probably in one way a little too favorable, because in calculating percentages the unknown cases are subtracted from the total number as though such operations had not been performed ; but as the individuals being entitled to pensions would, if living, almost certainly have presented themselves at the pension-bureau, one may conclude that they all died. On the other hand, a certain number of those operated on (primarily) may have sustained other undiscovered injuries to which, rather than to excision, their death will have been due.

unhesitatingly sacrificed. So with the coronoid process of the ulna, it is well to leave all the part to which the anterior brachial is attached ; and this can be done, even though all the articular portion be taken away. Also it is well to leave, if possible, on the humerus both condyles, and especially in young subjects to remove as little as possible, for the epiphysis here is rather shallow. The direction in which the bones should be sawn is a matter of some importance : whenever the extent of disease leaves any choice, I prefer cutting them obliquely, taking more from the anterior than from the posterior aspects, so that when the parts are adjusted the sawn surfaces may be in larger contact.

The subperiosteal excision is similar in the method of performance, but has the difference that the triceps is not separated horizontally from the olecranon, but is split up longitudinally, and left attached to the empty periosteum, from which that process of bone has been extruded. Thus the first incision is further out than that above described. But one must be sure to cut through the periosteum, and to carry the incision parallel to the fibres of the triceps, so as to divide none of them. Then, taking the elevator in hand, the surgeon, beginning below on the inner lip of the wound, peels the periosteum from the ulna, olecranon, and humerus, following, *pari passu*, the action of the elevator with the left thumb, just as one skins a bird for preservation. Behind the condyle great care must be taken not to let the instrument slip, lest it tear the ulnar nerve, which, if the operation be properly conducted, never comes into view, but is pushed with the other soft parts to the front of the inner condyle. Sometimes, especially about the attachment of the lateral ligaments, a touch or two of the scalpel may be necessary, but should not be employed at the back of the inner condyle. When the operator has ascertained that all this portion is free of soft parts, more especially that the nerve is safe, he separates, in one of the manners to be described, the internal lateral ligament. The separation of the outer half of the triceps is perfected in the same way as the inner (the radius need not be touched), until the external condyle is exposed. The external lateral ligament is now dealt with. The split periosteum and triceps are held apart by broad retractors, the joint is dislocated, and the ends of the bones extruded. The operation is not difficult to the practised hand ; but I ought to add, that in children whose epiphyses are not yet ossified, the periosteum or perichondrium cannot be peeled off with an elevator, but must be taken off by the knife, with as thin a layer of the cartilage as possible. In this operation the lateral ligaments may be dealt with in one of two ways—either simply divided, as in the common excision, or peeled off, as B. V. Langenbeck recommends, like the muscular attachments, with the periosteum. This latter procedure is not always easy, especially in young subjects ; it sometimes cannot be carried out with the elevator at all ; it then may be done by laying a knife under the periosteal flap flatwise on the bone and paring the tissue away.[1] The operation completed, a drainage-tube is passed into the depths of the wound (not between the bones), and the flaps

[1] This excision can also be performed by making only a little cut over the inner condyle, through which the conjoined origin of the superficial flexors and of the lateral ligament can be severed ; the principal wound and chief work is then done from a larger incision over the radius. This increases the difficulty of the operation—the incision in the subsequent position of the patient is badly placed for drainage, so that another opening has to be made. To my mind the only conceivable reason for electing this operation could be a pre-existing large wound (sword-cut or gunshot) at or near the outer condyle.

sewn closely, except where this appliance makes exit; the bones are to be closely applied, the dressings adjusted, and the arms splinted.

The after-treatment and management of a resected elbow has as much to do with the ultimate result as the operation itself. Its object must be threefold—good drainage, perfect quietude during the first few days, and means of movement afterward. My method is the following: previous to operation, I have a light splint prepared, consisting of a gutter for the upper arm, reaching from the axilla to about two inches above the internal condyle; another gutter, with hand-piece attached, extending not higher than two and a half inches below that point. These two are connected together by an interrupting bracket of considerable depth, which itself is divided into two portions united by a screw and fly-nut; the nut lying on the surface away from the arm, fixes or releases this pivot-like hinge. Upon this splint, bent to little more than a right angle, the limb already dressed is laid; the hollow left by the hinged bracket is filled by a pad thick enough to support the elbow, but short enough to be easily removable; the arm and upper arm-piece are secured by a well-applied bandage coated with dextrin or paraffin, or, better, since it dries quicker, with thin plaster-of-Paris; the elbow and bracket are enveloped in another bandage lying over, and therefore removable from, these more permanent ones.

The arm, when the patient is conveyed to bed, must be supported on two pillows, or on a simple swing thus contrived: the arm and forearm are put each in a loop of calico, to both of which, some distance above the limb, the ends of a rope about two feet long are attached. This rope runs through a small pulley, so that, according to the position the patient may assume, either the one or the other sling may be lowest. To this pulley is attached another cord, which runs through a second pulley secured to the ceiling above the bed, and which carries at its other end a sufficient counterpoise. Nothing more comfortable or permitting of freer movement of the body, without shaking an injured wrist or elbow, than this sort of swing, can be imagined: it is only requisite carefully to adjust the counterpoise, and for this purpose a little bucket, into which more or less shot may be put, is very convenient.

In this swing, and on this splint, the patient rests undisturbed until the dressing requires renewal. By pulling on the counterpoise the arm is raised from the bed, the outer bandage is removed, the dressing cut off, the wound laid bare, and if it look well should be simply dressed again, there being room enough between the bracket and the operation wound to pass the gauze bandage. Certainly for the first week nothing more will have to be done, but after that, unless inflammatory symptoms forbid, I would recommend the position of the joint to be changed every third day or oftener. This is to be done simply by loosening the screw and winged nut in the bracket-hinge, and alternately straightening or flexing the limb a little. It is well, too, after the fourth day, to move the fingers and thumb upon the splint. After twenty-eight to forty-two days, according to the progress of the case, the splint may be removed, the arm kept in a sling, and more energetic and complete passive movement may be given, or in a few cases more rigid rest must be enforced. Let me explain this. The limb, after this resection, may be rendered almost useless in two ways, either by a long, lax, fibrous union (flail-joint) or by synostosis, and the surgeon must jealously watch for indications of one or the other tendency; being at the same time aware that a fibrous bond permitting, quite early, easy and large mobility, will in a few months become too lax, it is better to be at first content with a considerably restricted movement—a good firm false union, admitting

of flexo-extension to only half the normal amount, is the best immediate result.

If it be found that stiffness is rapidly increasing, the arcs of movement getting smaller, and that synostosis is approaching, the surgeon must take care at all events to preserve the arm at or about a right angle. He may of course endeavor to keep a certain amount of movement to one side or the other of this posture; he may, under ether, try on several occasions to obviate this result, and he may, by perseverance, succeed. Synostosis is more frequent when the resection has been for injury or anchylosis; less frequent when the operation has been performed for disease, unless rheumatic: indeed, in my experience, neglect on the part of the patient—neglect which is often wilful, because he or she refuse to suffer a certain amount of pain—is, in pathologic excision, the most usual cause of synostosis.

Another termination, which one could wish were more frequent, is almost complete restoration of the joint; such condition has been found anatomically, and described by Czerny, Jagetho, and others.[1] In 1869 I saw a patient on whom I had operated in 1867, and in November, 1870, a patient of Mr. Canton's, who had lost his joint in the beginning of the same year. Mr. Canton had operated in the open manner, I by the subperiosteal method. My patient (Mr. Canton's was very similar) was in this state. He could neither straighten nor bend the joint quite, though very nearly as much as the one on the opposite side; pronation and supination, as well as all other movements of the hand, were perfect, and he followed his former occupation of a compositor—which requires considerable nicety of movement—as well, he said, as ever. The elbow was a little narrow through diminished size of the condyles. The rounded condition of the lower articular end of the humerus seemed to have been restored; over it played a bony hook-like projection, simulating but narrower and perhaps rather longer than the olecranon. The head of the radius, which had not been removed in the operation, rotated perfectly; it lay, however, a little farther forward than the norm. The triceps was attached to the skin in one part of the scar, but not sufficiently to interfere with its function. The man had no pain; his muscles were well developed and strong.

Case XCII.[2]—Daniel Hogan, aged thirty, came into the Charing Cross Hospital, under my care, May 22, 1860, and on the 26th of that month I, assisted by Mr. Canton, excised the elbow-joint. The size of the part and the position of sinuses induced me to adopt the H-incision. A free gush of blood from the exuberant synovial granulations followed the first cuts, but this soon diminished; the coronoid process of the ulna, the tuberosity of the radius, were spared, and as little as possible removed from the humerus; owing to the gelatinous thickening of tissues, and to the presence of a transverse cut, the arm had to be put up in a straighter position than I desired.

Some consecutive hemorrhage coming on, the parts had to be opened about two hours after operation, and a branch of the inferior profunda was secured.

He was ordered wine and twenty minims of laudanum.

On the sixth day he was able to sit up; the arm, from lying on the splint, had become flattened; it was ordered to be bandaged separately;

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[1] Langenbeck's Archiv, Bd. xii., s. 417.

[2] The earlier history of this case is related at p. 134; it is the only instance in which I have ever found it necessary to use the H-incision.

a bit of the end of the radius projected above the granulations, and looked white, as though it would exfoliate.

On the ninth day this part of the radius was covered with granulations, and the wound rapidly contracted. I ordered passive motion to be employed, and as there was a strong tendency to synostosis and to straightening of the arm, I had constructed a splint of wire-gauze, consisting of one portion for the arm, another for the forearm, connected together by a hinge. An india-rubber spring was stretched between these, at a due amount of tension, by means of steel hooks. In a week more the arm was more flexible ; he was able to take a walk, and was very much improved in health.

About the middle of July he caught a severe cold, followed by a smart fever and diarrhœa ; this necessitated his being confined to bed. At the present time (August) there remain two sinuses, which have the external appearance of superficial sores ; no dead bone has come away, and nothing can be felt with the probe. The fistulous passages do not seem inclined to heal, but the man has now very fair use of his arm, and it is increasing daily.

At the latter end of September, when I saw the patient again, the sinuses were healed, and had closed, as he told me, about a month before. He had excellent use of the hand and arm ; indeed, except that they were weaker, they did not seem worse than the fellow-limb.

Excision of the Wrist, is, in spite of improvements, made in the mode of its performance,[1] an operation of doubtful value. The object of the procedure is to remove the end of the radius and ulna, the carpal, and the bases of all the metacarpal bones, without dividing either artery or nerve, nor any tendon except the ulnar flexor and the long radial extensor of the wrist. After this has been done, the surgeon must be able to see clean through the rather large gap between the arm and what remains of the hand. It is evident then that Nature has a difficult task of repair to perform, a task which she rarely accomplishes very successfully.

In the hospital statistics of the last ten years I find recorded twenty-one cases, of which two died, and two are, in different years and institutions, reported as still under treatment. I have not been able to trace them in subsequent reports ; if we eliminate them altogether the percentage of deaths will stand at 10.5 ; if we distribute these two doubtful cases, giving one to success, the other to death, the percentage reaches 14.29.

Lister, in his papers, gives the details of fourteen cases, which all occurred to him in the Edinburgh Infirmary in twenty-five months. Of these cases two died, and one, whose result is not given, except that he had hospital gangrene, must be accounted as dead—mortality 21.4 per cent. These tables, added together, stand thus : Total 35, died 6—mortality 17 per cent. Pathologic amputation at the forearm bears a mortality of 10.77 per cent.

In taking the statistics of military surgery it is necessary to sift the cases somewhat. Otis,[2] who has done a great part of this sorting process for me, is able to give but six cases of excision of the joint as defined in civil surgery. Of these one died : 16.6 per cent.

Gurlt [3] gives a table from which we may eliminate five-eighths, and take

[1] Lister: Lancet, 1865, vol. i., pp. 307–335.

[2] Loc. cit., vol. ii., part ii., p. 999.

[3] Op. cit., p. 1259. This author gives a high number for excisions of the Handgelenk, but in most of these either more or less was removed than would bring the cases into our category.

only those cases which approximate closely the excisions of civil practice: these are 33 in number, with 8 deaths—or 24.2 per cent.

All this, however, is the least part of our inquiry ; we must see what results the patients, after threading this amount of danger, attain to. Of the twenty-one cases of London hospital practice, I have, partly by good luck, come across six. Of these one had a fairly useful hand ; he could write, but could not close the fingers nor quite straighten them ; he could lift nothing over a pound weight—this was six years after operation. Another had some imperfect use of the thumb. The other four had utterly valueless extremities—a leather arm, with hook and the usual tools, would have been infinitely more useful.

Of the eleven cases surviving Lister's operations, six recovered with some difficulty ; in three the wound was reopened for the extraction of more bone ; one suffered for a long time from exfoliations ; two had sinuses which lasted for more than a year. These survivors are spoken of as having fairly useful hands, but some of them, from the description, would not, in my view of value, fall under that category.

Otis says, of the five patients who recovered, two had fairly useful, two rather useless, and one utterly useless hands.

Gurlt gives,[1] of cases whose ultimate results have been collated, 16, of which but 1 may be called good, 8 middling, 6 bad, and 1 very bad.

If the choice between this operation and amputation were the only feasible one, we might still, in a few chosen and remarkably favorable cases, give decidedly the preference to excision ; but in the larger majority of instances a middle course is more than possible ; deep incisions, exposing, even penetrating among the bones, a little rest, then the forceps and the gouge, or fresh incisions, may effect much at this joint, or rather at this conglomerate of jointed bones ; nor do I think that more time is lost than by the protracted course of healing after excision.

The operation has, however, its place in surgery ; but too much result must not be expected. It should only be performed when the place of disease is most favorable—when the tendons are free—when the subject is young and has courage to undergo passive movements, and manipulations, that certainly are very painful. An Esmarch bandage and cord must be applied, since it is essential to see very distinctly the anatomy of the part, and the operation is commenced with an incision on the dorso-radial aspect of the index metacarpal bone ; it is to occupy a little more than the upper half. Just before reaching the base of that bone it turns inward at an angle of about 120° or 130°, and coursing a little inside of and parallel to the tendon of the extensor secundi internodii pollicis ends just above the radio-carpal joint, close to the outer edge of the extensor communis digitorum, where that muscle crosses the one above-named. This incision divides the short radial extensor, but spares the longer one. The next steps are to push—and I prefer for this purpose an elevator—the tendon of the extensor of the second phalanx of the thumb, together with the radial artery, well to the outer side of carpus, enclose them in the crook of a retractor, and hand them over to an assistant ; to separate the long radial extensor from its attachment with the knife, and the trapezium from its carpal connections with cutting forceps. To do this the cut with the forceps must be nearly longitudinal, *i.e.*, nearly parallel with the first incision. Nothing more should at this stage be done on the outer side of the wound ; but on its inner side the tendons of the extensor digitorum may be lifted

[1] Loc. cit., p. 1316.

away from the radius as far as the dissection seems safe. The surgeon now goes to the inner side of the limb, and here I would recommend a slight deviation from the form of incision which Lister recommends, namely, a straight incision on the ulno-palmar side of the hand and forearm. More room is obtained, the depths are more easily reached, and less injury is done, if the incision be begun on the inner and rather posterior surface of the fifth metacarpal bone, and continued to its base, then run obliquely across the inner aspect of the carpus to the pisiform bone, and thence take a slightly sloping course backward and upward for two inches on the subcutaneous surface of the ulna, skirting the flexor carpi of that side. The two flaps thus marked out inside the wrist may then be turned forward and backward, taking care to include all the soft parts, especially the tendon of the flexor carpi ulnaris, which is to be dealt with hereafter ; then the extensors of the little finger, the common one, and the indicator, are to be raised with an elevator from the carpus. The two wounds now communicate beneath these tendons, and the back of the carpus may be cleaned by putting the left index into the radial wound to guarantee the artery with the extensor secundi internodii, by keeping the knife in the ulna wound, dividing the posterior ligament, and clearing any other obstruction away. In withdrawing the knife divide the internal ligament. We next turn to the front of the wrist, nip off with pliers the unciform process, and passing the periosteal knife under all the flexor tendons, separate them from the bones, taking care not to tear the deep palmar arch. Now the carpal bones will be loose enough to extract, with sequestrum forceps, either in one clump or separately, except the pisiform and trapezium. By making good extension on the hand and turning it outward, the ulna and then the radius are easily protruded from the inner wound, and as much but no more than is absolutely necessary removed ; the radio-ulnar articular surfaces should always be taken away, but by an oblique cut this may be done without sawing off much in length, especially it is well, if possible, to leave the styloid of the ulna. After this extrude the metacarpal bases, and here, too, as little as possible, but all that is diseased must be removed ; the attachment of the radial flexor must, if feasible, be spared. Sometimes this part of the operation requires two phases, for the inner bones come best out of the ulnar, the outer out of the radial wound. The removal of the portion of the trapezium which is still left attached to the first metacarpal bone is a very delicate part of the operation, since it must be effected without wounding the radial artery, or the radial flexor tendon. A strong, well-dentated pair of dressing forceps, that will not slip off, while cautious touches of the knife are being applied, will greatly assist the operator. The base of the first metacarpal bone may next be examined, and, if necessary, removed.[1] The pisiform bone should also be taken away entirely, or in part (it can easily be shelled out of the tendon).

The operation, like many others, is more complicated in its description than in its performance ; but it is a long and arduous one, even when the parts have undergone pretty severe disease, and therefore are separable ; under other circumstances, and on the dead subject, it is very difficult.

The Esmarch cord should now be removed, while the radial artery is closely watched ; if no blood come from it, other bleeding vessels that are attainable may be tied or twisted : it is a great desideratum to avoid having

[1] One of Lister's less fortunate cases suffered recurrence of caries at this part. Erichsen advises that it be always taken away : Science and Art of Surgery, vol. ii., p. 265, seventh edition.

the cavity filled with blood. If the radial artery have been wounded or torn, it becomes a question whether or no to amputate—a question that I would answer in the negative, for the communication between this and other vessels is so free, that I should rely on them for nutrition of the parts beyond. The artery, if quite divided, must be tied at both severed ends; if only wounded, an aneurism needle may be passed beneath, the catgut divided in the eye, and one-half tied above, the other below, the vascular rent.

The truncated ends of radius and ulna on the one part, and of metacarpus on the other, are to be brought into close apposition; then the front of the limb is to be laid on a flat wooden splint, provided with a semilunar pad of cork to support the palm and fingers, and with an outrigger of the same material to uphold the thumb, the wrist being maintained in slight extension. Just at first the fingers as well as the arm should be bandaged, afterward this may be discontinued for the former parts, passive movement of which must commence very early; the wrist being kept well at rest until some considerable amount of consolidation has set in, when pronation, supination, and extension are to be used; flexion being further postponed. Any deviation, as of the whole hand to the ulnar side or adduction of the thumb, must be watched for, and at once counteracted.

Metacarpo-phalangeal Joints.—Excision of interphalangeal joints is not much practised, for, although a case of such operation may here and there have been followed by complete success, the finger is very apt to remain stiff and useless, or indeed worse than useless; but excision of metacarpo-phalangeal joints, more especially of the thumb and of the index finger, is a valuable operation.

The former may be effected through a longitudinal incision made along the anterior aspect of the joint, the latter through one on the outer aspect, carefully sparing the insertion of muscles, the short flexor in the one case, the interosseus and abductor in the other; or turning them aside with a raspatory, the surgeon divides the external lateral ligament and partially dislocates the phalanx; by adducting it considerably, and making traction, he opens the joint, and introduces a narrow blade to its inner side, when a few cautious touches will sufficiently sever the internal lateral ligament to permit complete dislocation, the end of the phalanx projecting through the wound. As little as possible must be removed from this part; and now, the thumb being turned more completely over, the head of the metacarpal bone projects, and with a small saw may be removed. A leather or gutta-percha splint is then moulded on the limb; the back, if it be the thumb; the back of the hand and spirally to the inner side, if it be the index. Passive movement should commence, gently at first, in from ten to seventeen days.

Case XCIII.—Mrs. L., aged twenty-five, kept a pet monkey, which one day in a rage flew at her face; she put up her hand, and was bitten at the metacarpo-phalangeal joint of the thumb. The teeth of the animal laid the joint open; suppuration supervened, and she suffered greatly. Two months after the injury, Dr. Cope, then of Croydon, brought her to me, April, 1871. The thumb and hand were a good deal swollen; the joint was open, an ulcer on the front aspect leading directly into it—it was quite bare of cartilage, the phalanx could be rotated on the metacarpal bone. After some efforts to save the joint—which we told her would probably not avail, but which reduced the inflammation of parts around—I excised the base of the phalanx and head of the metacarpal bone on May 3d of the same year, and placed the limb in a leather splint. The case was skilfully attended to by Dr. Cope, I seeing it occasionally. Passive movement was begun on the

fourteenth day. The wound at that time was nearly healed, and it quite closed on the twenty-second day.

On August 28th the photograph from which Fig. 78 is copied was taken. At that time the thumb had regained all its natural and had no abnormal movements ; she could use it perfectly in all her usual employments—could sew and knit, and even hold articles of considerable weight. The scar on the front aspect was so slight as to show but little in the photograph ; there was some slight enlargement of parts at the site of the operation. I could

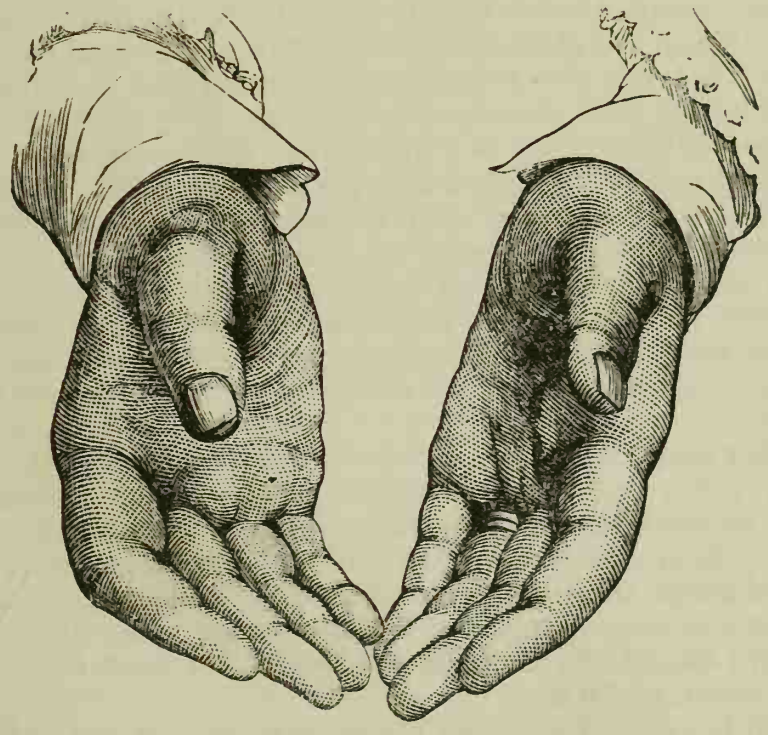

FIG. 78.—After excision at first joint of thumb.

not ascertain distinctly what method of reunion had taken place in this case ; the ends of the bones seemed but little altered in shape : it is probable that they became rounded off, and united by a firm and close ligamentous tissue.

Excision of the Hip.—The first removal of the articular part of a long bone befell, in 1742, the head of a femur ;[1] but probably—for Schlichting's case was most likely merely removal of a sequestrated epiphysis—the first intentional and scientific decapitation of the femur is due to Anthony White, of the Westminster Hospital, and bears date 1822. The example was followed by Hewson of Dublin, in 1828. The next English case belongs to Sir William Fergusson, 1844 ; but during that interval the operation had been performed six times in Germany, with success only in two cases. Sir William Fergusson's Paper [2] called attention to the value of the operation, which since that date has been frequently performed, becoming, in a few years, one of the recognized and most valuable of surgical procedures.

The operation must be considered from a standpoint rather different to that of other excisions. Amputation at this joint is extremely dangerous,

[1] See p. 394. [2] Medico-Chirurgical Transactions, 1845.

and leaves the patient in a very mutilated condition. It would therefore only be preferred to excision under certain of the circumstances already alluded to. Again, severe hip disease occasionally exposes the patient to such horrible suffering that the merciful surgeon feels bound to operate, even though his expectation of saving life may be very small. Hence a larger death-rate than would otherwise ensue. The operation, considering the depth at which the joint lies, is by no means severe ; little blood is lost, and the subsequent pain is of short duration : indeed, if the disease be accompanied by much suffering, the patient seems relieved rather than otherwise. The mortality, taken from the Reports of six large metropolitan hospitals, is high, viz., 45.73 per cent. I place, in arranging the statistics, all cases which are at the end of the year reported as unrelieved among the deaths. This may give a slightly exaggerated mortality, but not sufficient to distort our view of the proceeding.[1] Dr. Sayre, in his "Orthopædic Surgery," gives a table of his own operations (subperiosteal), 59 cases. Of 3 no result is recorded ; we must take the number as 56. Of these, at the time of writing, 20 were dead.[2] The mortality then stands at 35.7 per cent. Mr. Croft's interesting paper [3] gives 45 cases : of these, 2 results uncertain and 11 still under treatment must be omitted, leaves 32 cases, whereof 16, or 50 per cent., die. I consider that from 40 to 45 per cent. may be taken as the average result. We must, however, remember that a number of these operations are undertaken, in cases evidently doomed to death, to save, not life, but pain.

In military surgery, and for gunshot injury, excision of the hip is terribly lethal. Prior to 1861 there were 12 recorded cases, of which 11 died. During the American war 63 operations were performed, and, of these, 58 were fatal ; in the former series 91.66, in the latter 92 per cent. of deaths.[4] It should be stated that cases of this injury temporized, left unoperated, die at the rate of 95, amputated at that of 89.9 per cent. The various German wars give statistics thus : total number, 53 ; of these, 5 cured, 48 died ; percentage mortality, 90.56.

To return to civil surgery : Of the 55 or 60 per cent. of patients saved, a certain number recover with very useless limbs. This proportion I find impossible to fix absolutely in numbers ; but, from observations of those cases which I have been able to follow for a sufficient number of years, and with the exceptional opportunities afforded me at two Homes for Cripples, I would judge that about 27 per cent. of those cured have useful, about 46 per cent. partially useful, about 27 per cent. utterly useless limbs, using, in progression on crutches, but one foot.

Among the good results are some *very* good, such as that depicted at p. 433 ; the patient walking with barely a limp, able to flex, abduct, and rotate a little in both directions, the very slightly shortened limb. Among the bad results we must reckon some patients who attain that end by their

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[1] The table in full stands thus : cured, 54.27 ; unrelieved, 25.38 ; died, 20.35.

[2] Dr. Sayre considers a number of these deaths to be independent of either the operation or the disease ; but dysentery, degeneration of liver, and nephritis, given as the fatal causes, are just those conditions which, through lardaceous changes, do kill patients with suppurating joints or unsuccessful joint-operations.

[3] Clinical Society's Transactions, vol. xiii., p. 66.

[4] These numbers are taken from Dr. Otis's Report, Circular No. 2, War Department, Surgeon-General's Office. The Surgical History of the American War has as yet only reached to injuries and operations of the upper limb ; thus these numbers give, as shown by comparison with the more matured work, for the upper limb but a portion of the surgical achievements.

own negligence. When the operation-wound is healed and the patient is able to get about on crutches, he is usually discharged from the hospital. We enjoin movement and exercise of the limb, but the injunction is very rarely carried out, the muscles are never employed, and the limb becomes, as years go on, more and more incapable of movement and support, simply from muscular disuse. Such was the state of affairs in the case here depicted, which was in 1860, by the kind permission of Mr. French, late of Marlborough street, photographed from a patient whose dislocated caput femoris he had removed twelve years before. The limb was ill nourished, the foot and leg cold and inclined to be purple, and in two spots ulcerated. This resulted merely from the pendent position in which the girl kept it. Had she moved and used it, the thigh need not have been so weak:[1] but it must be acknowledged that the amount of real shortening, unavoidable in luxated cases, threw great difficulties in her way (Fig. 79).

Excision of the hip may be performed by the super- or subperiosteal method. For the former many forms of external incision have been used; these are a matter of little consequence, provided only that a depending and sufficiently free outfall for pus be provided. I prefer a simple semilunar incision, beginning about half an inch or more above the anterior angle of the trochanter, sweeping round the back of that process, then swerving forward again, and terminating over the front margin of the femur. The distance between these two anterior horns would be in the adult about four inches, in the child about two and a half inches. The flap is to be thrown forward, dissected deeply, so as to leave the bone covered only by its tendinous expansion. The middle gluteus will be seen running obliquely from the pelvis to the anterior margin of the trochanter. The knife is now to be sunk to the depth of half an inch behind the process, about its middle as regards length, and being made to skirt the bone very closely, passes to its upper edge and onward to the margin of the gluteous tendon; here it changes its position, for, instead of being held perpendicular to the surface, it should now be horizontal, lie flat on the outer face of the trochanter, pass under the edge of the muscle, and, as it still descends, gradually resuming the perpendicular, it detaches the tendon from the bone rather than divides it. It is well, though sometimes this act pares away the pyriformis, to make sure of its separation, and to divide the tendon as close to the bone as possible; also to let the knife pass along the anterior margin of the trochanter for nearly half its length. Now the digital fossa is to be sought, and the obturator externus and internus divided in it. Upon the next point of the operation I wish to lay particular stress, for upon that phase depends the completion of a good excision or the prolongation of a tedious and not very creditable performance. The tendons being then divided in the digital fossa, the surgeon with his left forefinger presses them inward; all he has to do is to make quite sure that the tendons are cut, then to pass his finger into the gap, and glide it, with a swaying up-and-down movement, upon the capsule of the joint covering the neck of the bone toward the acetabulum. He can now distinctly feel the margin of this cavity and the caput femoris passing into it; keeping the finger on that place, he guides the scalpel to the spot and sinks it into the joint; as the blade now lies secure in the acetabulum it can be swept almost entirely round within the cavity, first upward and toward the front, then downward to its inner or lower aspect; the part below the joint needs no division.

[1] The apparent plumpness of that part is merely a peculiarity of sex: the soft parts consisted almost entirely of fat.

Now even a slight inward rotation and adduction of the thigh will luxate the head of the bone and extrude it at the wound.

The operation, thus performed, leaves all the muscles as long as possible, and as they are not cut in their fleshy, but only in their tendinous sub-

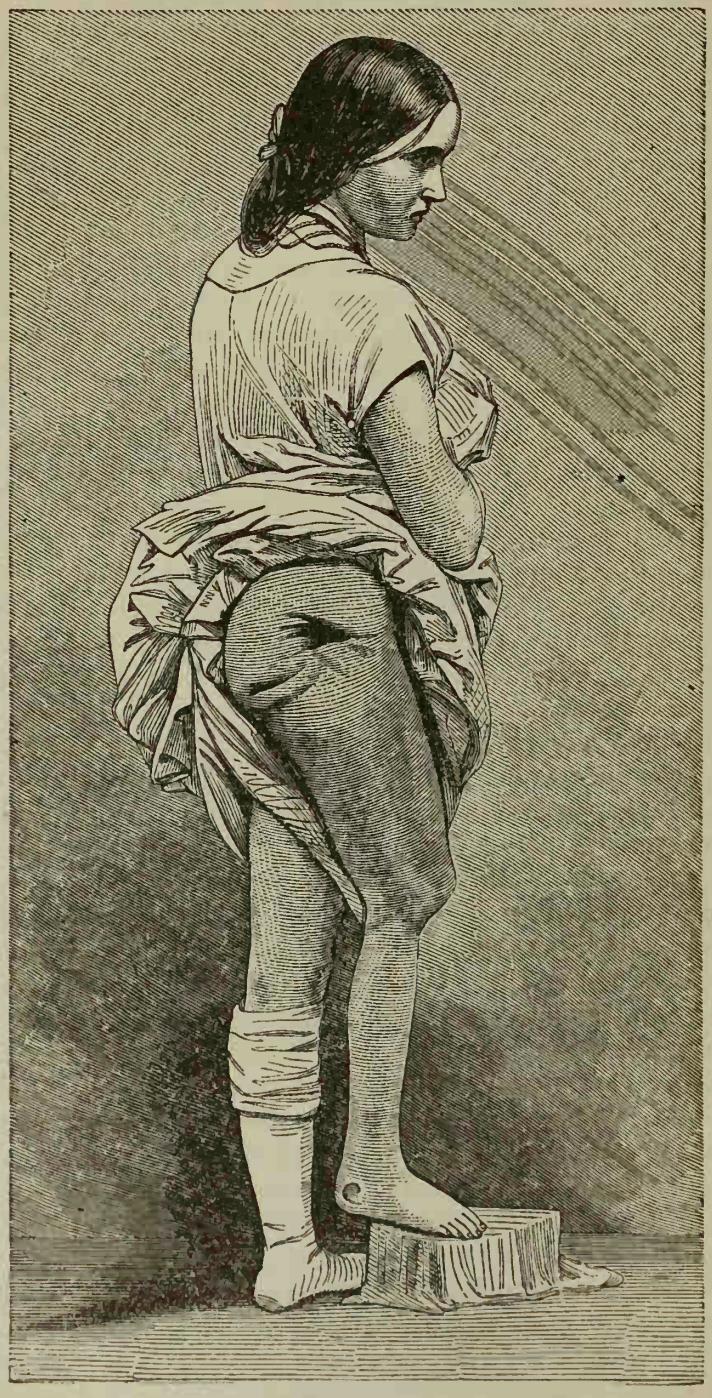

FIG. 79.—M. E. Twelve years after excision of the hip.

stance, very little bleeding is produced; also, when the internal obturators are pushed back from the neck of the femur, the long outward branch of the internal circumflex artery, that lies with them, is also pushed away and therefore is spared.

Subperiosteal exsection is performed in a very similar manner. Dr.

Lewis Sayre, of New York, the chief exponent, if not the inventor, of this operation, speaks of it very highly. I will here describe his method as I follow it, for I confess myself unable to understand the description of his first incision, or, if I take his words literally, I should venture to object to this point, "drive the knife to the bone midway between the anterior inferior spine of the ilium and the top of the great trochanter; then drawing it in a curved line over the ilium, keeping it firmly in contact with the bone, make an incision across the top of the great trochanter;"[1] it appears to me probable that Sayre's words do not here describe what he really does, because farther on he lays stress on preserving the muscles, but the procedure, thus recommended, must cut them. I perform the first steps of Sayre's operation exactly in the manner I have already described, and take even additional care in reflecting the flap that the posterior margin of the gluteus medius should be well defined and the outer face of the trochanter be clearly visible. I then make a longitudinal incision *quite through the periosteum*, from the top of the great to a spot opposite the lesser trochanter, and, at two-thirds of its length from the upper end of this cut, I cross it by another which runs from the front to the back of the bone; then feeling for the digital fossa, I divide the obturator tendons. Now the scalpel is laid aside and the elevator taken in hand. Beginning at the lower part of the longitudinal opening, I, with a firm hand and a wriggling motion (a movement which twists the flat of the blade to right and left alternately), separate the periosteal flaps one after the other, go round to the front, top, and back of the neck of the femur; then, since now the attachments are loosened, lift the bone a little from the acetabulum and free the lower part of the cervix. The detachment of the glutei and pyriformis requires a careful and powerful hand; the elevator must not be allowed to slip and rend the membrane. When all has been detached, a little adduction and inward rotation of the thigh brings the head and neck of the bone out at the wound, and the required part may be removed with the saw, or, if more than is already denuded must be taken away, gentle pressure upward, and sometimes a little pushing with the finger, will cause the bone to glide out of its sheath quite easily to the required distance.

There are sometimes obstacles to this operation, the chief being imperfect ossification of the trochanter, to which, while it remains cartilaginous, the periosteum (perichondrium) adheres with indissoluble tenacity. In such cases, and of course they are not uncommon, the difficulty must be overcome by commencing the peeling process below the apophysal line, doing all that is possible from that point, and then, since we have a detached lappet to start with, try once more over the cartilaginous surface; if still the membrane cling too firmly to be flayed away, it must be cut off, together with as thin a layer of cartilage as possible. It has twice happened to me, when the femur was extensively softened, that very little force, certainly not at all more than usual, has detached the trochanter *en masse*. This had no bad effect on the after results; the operation was easily completed, and the part (which cannot be drawn up by muscular acts, as it is still enclosed in periosteum) was found, in the after event, to have united to the new bone.

By one or other of these methods the operation ought to be done; any infelicity, which may culminate in sawing off the neck of the bone *in situ*, and dissecting or dragging the head out afterward, is to be deprecated; it may lead the surgeon into trouble he will hardly get out of. Even if he escape tribulation, but require to cleanse the acetabulum, he will have in-

[1] Sayre's Orthopædic Surgery and Diseases of the Joints, p. 288.

sufficient room for the purpose, unless he again apply the saw to the femur. This leads us to consider how much of the femur is in either of these operations to be removed, supposing the disease to be so limited that the surgeon has any choice. My strong recommendation is to remove, in every case, the head and neck, together with the greater part, if not all, of the great trochanter. Never, on any account, should the neck be sawn off by a perpendicular cut, leaving a surface that looks directly inward toward the pelvis. I have often seen this done, and in one or two cases without evil results; but if the acetabulum require the gouge, there will be difficulty in applying it; and, what is more important, when all is complete, the flat surface and the trochanters are apt to fall against the acetabulum, to shut it up like a valve, and to favor retention of pus.[1] I myself always remove at least half of the great trochanter. Beginning below the middle of the square facet, I saw, with a little downward obliquity, across the bone, to a point rather above the lesser trochanter. If the operation have been extra-periosteal the muscles will, if they have been cut long, re-attach themselves, since the shortening is compensated by nearer approach to the pelvis through absence of the neck. If the subperiosteal method have been followed, all this portion of bone, except the head, will be partially replaced.

If real (p. 287) pathologic dislocation have occurred, a slighter operation will remove the head of the femur, supposing that continued caries and abscess still demand this operation. In such cases the bone is almost subcutaneous, and a simple semilunar cut and a little dissection over the projection suffices. Sometimes the dorsum ilii under the displaced border will be found carious, and must be gouged. In one case I found the greatly diseased caput united by bone to the ilium; I had to remove it with saw, and chisel away parts on the ilium till I secured a smooth, hard surface.

When in the usual operation the surgeon has removed the head of the femur, he must examine the socket. To my late colleague, Mr. Hancock, belongs the honor of first pointing out that disease, even extensive disease, in and about the acetabulum, does not forbid, but, on the contrary, more strongly indicates, the operation of excision.[2] Previous to that surgeon's papers every operator excised, under the dread that he should find the pelvic bones implicated; indeed, it was taught (Dr. Knox) that the pelvic portion of the hip-joint is beyond the reach of excision. Previous, then, to Mr. Hancock's paper only decapitation of the femur had been performed, never a real excision of the hip-joint. These matters, elucidated by my predecessor, and strongly insisted on in the first edition of this work, are now so well known that I need not describe at length how the internal wall of the acetabulum is separated from the pelvic viscera by, from without inward, the internal obturator muscle, the fascia of the same name, the levator ani, and the pelvic fascia; nor need I again (p. 278) point out the fact that when that wall, becoming diseased, gives rise to abscess within the bony pelvis, these parts are pushed inward, often considerably inward (Fig. 48), leaving ample room for the careful application of trephine, gouge, saw, or forceps, without any injury even to the most superficial of these parts. Therefore the surgeon may now, when the proper quantity of the femur has been removed, pass—without dread of what he shall find—his finger into the acetabulum. In many cases he discovers only a cavity lined with that

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[1] In a case thus operated, and which I was asked to see ten days afterward, I put my finger into the wound and pushed the end of the femur forward, when a quantity of offensive grumous pus flowed from the cavity.

[2] Lancet, April 18, 1857.

soft velvety material which he knows to be bone-granulation ; sometimes at the bottom of such a hollow he finds an opening leading into the pelvis. If its edges be smooth, and also granulating, let him leave this alone. The same if they be hard and smooth, though bare ; but, if soft and friable,

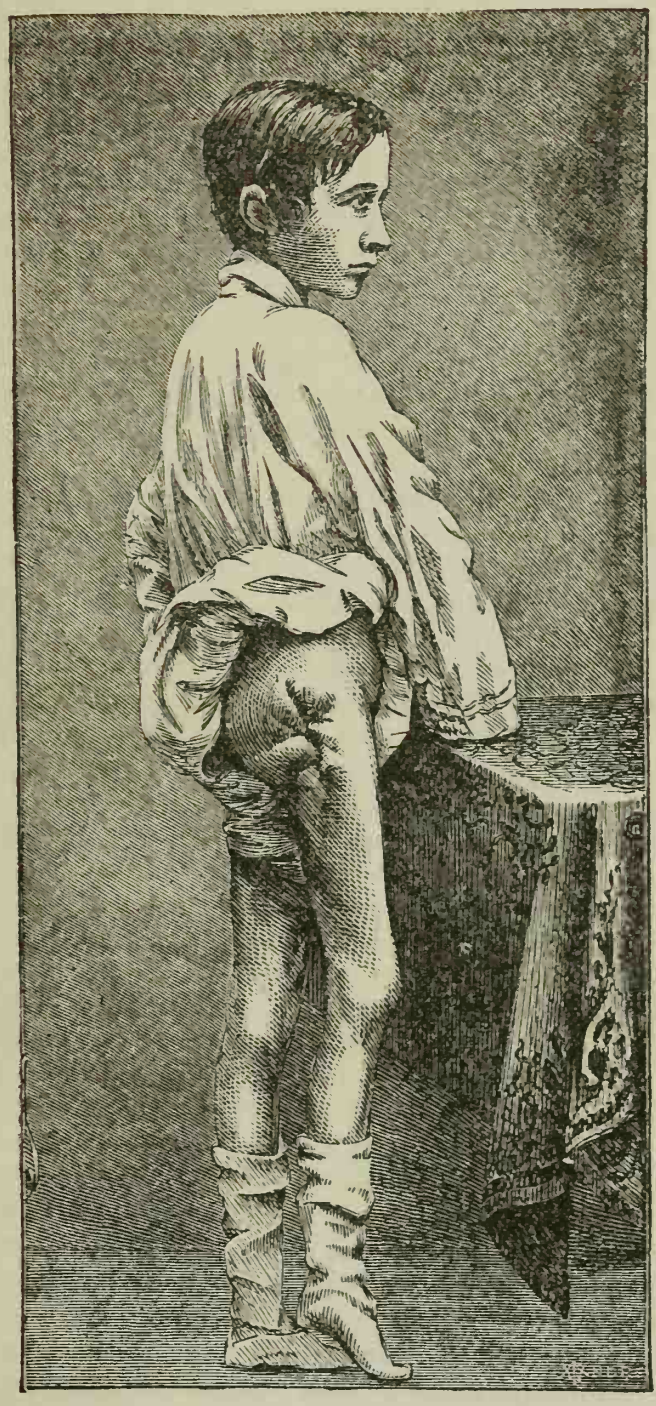

FIG. 80.—From a photograph of Timothy D., four months after excision of the right hip.

he must gouge away all parts that answer to such description. Oftentimes this hole, whatever condition its edges may be in, will be partly blocked by a necrosed piece of the floor which has loosened itself from the rest, and may be extracted with the forceps. Sometimes, although certain parts may be covered by tender granulations, the rest—the chief part, or, worse still,

all the acetabulum and neighborhood—is softened, suppurating, and carious. Now, however extensive the disease, it must be removed. Often a trephine crown will cover it; sometimes a large part of the floor must be cut out with a narrow saw. I have often removed great portions of the innominate. In one case that succeeded admirably, a great part of the ischium, some of the pubes, and the ilium, almost to the lower curved line, were removed. The quantity sawn and cut away half filled an ordinary bleeding-bowl, yet I nowhere trenched on healthy tissue.

Mr. Hancock illustrated his views by the case of

Case XCIV.—Timothy D., aged fourteen, on whom he operated in December, 1856. "The boy at that time had several abscesses, among them one opening at the groin, into which a probe being introduced passed into

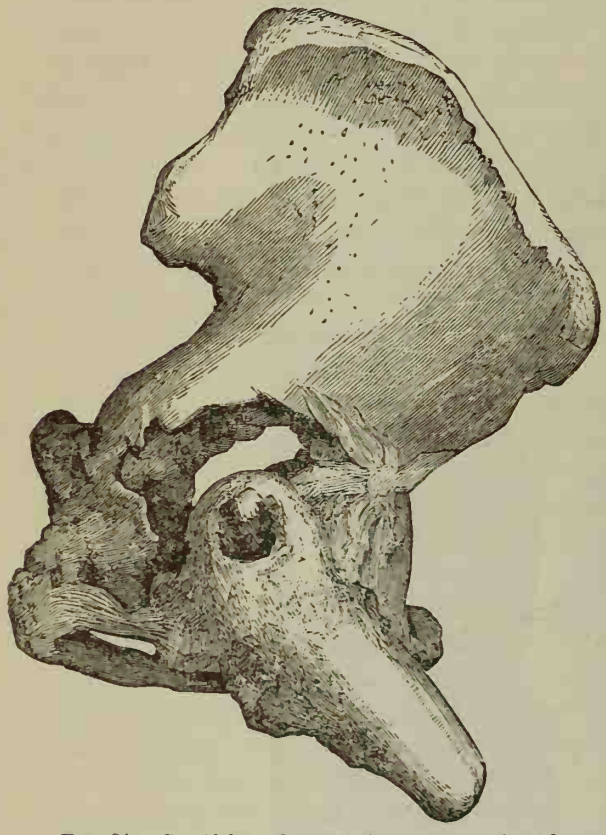

Fig. 81.—Condition of parts nineteen months after excision of the hip-joint. The femur turned out of the cavity.

Fig. 82.—Condition found nineteen months after excision of hip. Parts *in situ*.

the pelvis. Finding, after removing the head and the neck of the femur, that the acetabulum was diseased, and communicated by two large openings with the pelvic abscess, the whole floor was removed with a metacarpal saw. The painful symptoms rapidly disappeared, and the boy got on extremely well. In the beginning of April he was sent to Ramsgate, after being, by Mr. Hancock's kind permission, photographed. The constitutional vice, however, broke out elsewhere; phthisis was diagnosed in July, 1857, and he died of that disease in 1858. Until the lung malady had greatly weakened him, this boy could walk very well: he had but little flexion power over the thigh, but could bear upon it the whole weight of the body; a small opening in the tract of the wound and some discharge still remained.

I was fortunate in being able to procure the parts implicated, which are

of high interest. The acetabulum, or rather the enlarged cavity which must go by that name, has an unevenly serrated edge; probably little modified, by absorptive process, from that left by the operating saw. Its upper part was covered by a peculiarly dense fibrous structure, except a point at the back about the size of a sixpence, which was carious merely on the surface. Its fundus was largely perforated, and the edge of the perforation was still granulating, in parts covered in by a fibrous tissue. All this could be best seen when the femur was turned out of the cavity, as in Fig. 81, also, the truncated end of the bone, which was rounded off. The extremity of the medullary tube was partly closed by a thin plate of bone; the opening, being ragged and lacerated, looked as though the osseous covering had once been complete. The position of the femur during life, however, was as depicted in Fig. 82; it abutted against that sawn surface of the pelvis which now represented the upper lip of the acetabulum, and was enclosed in a capsule of dense fibrous tissue (a triangular flap of which is represented as turned down), deficient at a small posterior point whence pus, still secreted by the bony granulations and carious spot, escaped. The ramus of the pubes and ischium was deflected inward, singularly adapting itself so as to make room for the femur in its new position.

This case is very instructive, showing clearly not merely the possibility of reaching and emptying intrapelvic abscess, but also that the surgeon's duty is to recognize such condition, and to act upon the indications thus afforded. Following these lines, I have on several occasions removed the head of the thigh-bone, and either simply trephined the acetabulum, or, the *caries necrotica* being more extensive, have taken away large portions of the pelvis. I will briefly report one case, in which a singular symptom pointed more strongly than usual to the necessity of prompt action, only premising that the same circumstance has occurred to me in two other cases. I refer to the contractions of the levator ani during micturition, squeezing pus from the intrapelvic abscess through an external wound.

Case XCV.—James O., aged ten and a half years, was brought to me July 20, 1875, having suffered intermittingly during the last four years from left hip disease.

He was thin, pale, unable to put the right foot fairly to the ground. The right limb was much shortened. Three old sinus-mouths—one on the thigh outside the rectus, one in the outer part of groin, and one on the inside of the thigh, two and a half inches below the perineum, were strongly depressed. Besides these, an opening behind the trochanter discharged a considerable amount of pus. The boy's mother said that, when he passed water, pus flows out of this opening.

I examined him carefully. On pressing into the iliac fossa, tumefaction, extending down into the true pelvis, was plainly perceptible. On examination per rectum, and on pressing the finger toward the right and forward, a certain swelling could be felt, and, on gentle manipulation, the side-wall of the bowel was found to be pushed slightly over. Still, these signs were not strongly marked. I arranged so as to see the lad make water, and found the mother's statement to be true; indeed, I was somewhat surprised at the quantity of pus that flowed. This was, no doubt, due to the action of the levator ani muscle.

The boy was thin and anæmic, with dry, harsh skin, sometimes sweating toward morning. Appetite capricious; liver rather enlarged; generally constipated, but having occasional diarrhœa; urine normal; pulse aver-

aging 100, small. Temperature in the morning varying from 97.2° to 99.8°, in the evening from 101.5° to 103°.

July 26th.—I excised, by extra-periosteal method, the head of the femur, and, passing my finger into the acetabulum, found that most of its walls were covered by granulations; but that at the bottom was a bare, necrosed surface, irregularly shaped, and about the size of a shilling. To this I applied a trephine-head, and removed a circular portion, and then, still finding softened parts, gouged them away. On the first perforation of the pelvis about five ounces of pus flowed; and when the opening was complete, the finger, passed through it, lay in a wide cavity within the pelvis. This cavity was injected with a three per cent. solution of carbolic acid, a drainage-tube was passed in and the wound dressed.

The boy was relieved by the operation, and in a week the temperature chart improved. His recovery was slow, but uninterrupted, and the ultimate result excellent.

The dressing of these cases is simple, but important. If the extra-periosteal operation have been performed, the muscles must be replaced as nearly as possible in their normal position—an easy matter if they have been cut long, as directed. The two cornua of the external incision are sewn, a drainage-tube inserted in the middle of the semicircular incision, which also is its most depending part. If subperiosteal exsection have been practised, we must, besides providing for drainage, find means of keeping open the bag from which the bone has come: the sides must be held apart; for this purpose tenax is a very good material, as it is both antiseptic and porous. I would not, however, use it alone, but wrap a certain quantity around two drainage-tubes, and introduce them separately, of course sewing up the rest of the incision.

The immediate apparatus to be applied is not a matter of so much importance at this as at some other joints. Dr. Lewis Sayre puts his patients at once into a wire-web apparatus, which fits the posterior half of the body and lower limbs; and I have tried several means of immobilizing the operated limb, but have come to the conclusion that the best means, except for very small children, is to fix the body and sound limb either by a long Desault splint or draw-sheet and sand-bags, as already so frequently mentioned, while extension, at first moderate and gradually increasing up to 1½ lb. to 3 lbs., according to the size and strength of the child. In arranging this extension (the pulley appliance already described is the best), care must be taken to keep its direction that of abduction, in order to avoid any unnecessary amount of shortening.

When the patient is quite little, from two to five years old, I employ a more immobilizing apparatus, namely, a plate made of very thin metal, which extends from a little below the nipple to a little above the knee. Running from this, not quite at a right angle, is a part cut from the same plate, which, crossing the abdomen, reaches to the anterior iliac spine of the opposite side. This plate, shaped like a cross with but one arm, is moulded to fit the surface, and is strengthened by an iron wire along the middle of each plate, and of course on its non-applied surface. It is covered with wash-leather, and when the wound is dressed is placed *in situ*, and the whole—limb, splint, and pelvis—enveloped in plaster-of-Paris, which renders the limb quite immobile, but leaves ample room for any dressing that may be desired.

The Local Cause of Failure after Excision of the Hip is nearly always Osteomyelitis of the Femur.—There is certain but small number of cases, in which

continuance or spread of caries about the pelvic bones produces non-closure of the wound and abundant discharge, with the usual constitutional sequelæ of that action. There are also a certain number who, having already lardaceous disease prior to operation, succumb the more rapidly because this measure, having failed in at once stopping the discharge, tends to accelerate that degenerative process. The former cause is very generally a result of inadequate removal of disease from the neighborhood of the acetabulum, the latter is occasionally an infelicitous choice, sometimes unavoidable, of the case or of the operative procedure. But osteo-myelitis of the upper end of the femur stands in a different category. Yet there are, one is happy to believe, very few instances of the surgeon leaving behind a bone with any marked degree of inflammation ; also there are few operated children who do not, after the first few hours, manifest distinct signs of improvement ; but unfortunately there are many who, after a week's or a few weeks' satisfactory progress, retrograde again, with symptoms of increased suffering, of deep-burrowing abscess, and of bone-inflammation. On examining such a case, the end of the femur is found enlarged and soft. I have had several opportunities of bisecting and studying such bones after amputation or after death ; in them I have always found osteo-myelitis commencing at the place of section, analogous to the same condition of amputation stumps. In excisions its preference is, however, almost exclusively for the upper end of the femur. It is, after hip-excisions, the most frequent cause of death, either early from pyæmia, or late, with unclosed, suppurating wound, from lardaceous disease ; it is also the hidden meaning of cases in hospital reports which are noted as "Unrelieved," or only "Relieved."

The condition is not the direct result of operation, nor of the application of the saw to osseous tissue, but is produced by the contact of pus or wound-secretion with the medullary membrane. If previous to operation the joint-cavity be freely suppurating, if a sufficiently depending opening be not allowed, the malady commences early. If, even in cases that have progressed quite well, the superficies of the wound be allowed to close before the depths have been filled by granulations, a late appearance of osteo-myelitis is almost certain. A case, only a short time ago, marked this latter sequence of events very well : the patient was progressing admirably, seemed about to get well without a trouble or a pain ; but the wound was allowed to heal, when almost immediately suspicious symptoms came on, and in two days deep, hard swelling around the bone declared itself. The operation-wound was opened up, a few drops of thin pus escaped, and the child rapidly got well, but his wound was not allowed to heal for some weeks.

The treatment of this condition must of course be local, and should be, where possible, preventive ; thus, if I excise a hip, about which much suppuration is taking place, I carefully examine if any part of the operation-wound will be in the most depending part of the cavity. This is very seldom the case, and if it be not so, I pass from that lowest point a large drainage-tube through the integument, making a new but small wound for the mere purpose of keeping the cavity clear. If the place for entrance and exit of this drain-pipe be well chosen, the operation-wound may be allowed to close sooner, and the cases certainly do better. If but little pus surround the bone, the operation-wound will generally suffice, but the case must be watched, and on the first appearance of osteo-myelitis, a better outfall must be given ; or if it arise from a too quickly healing incision, that wound must be reopened. The limb, instead of being kept horizontal, should be raised, while extension is still applied. The general treatment must be like that already described. I will only observe that first quinine and then

ergot of rye seem valuable, if the temperature be high ; the former is my sheet-anchor in cases of commencing pyæmia, and I believe myself to have kept off such disease by its free use.

A few words upon the choice of cases for operation. It has been said (p. 421) that amputation at the hip is so very dangerous and so very root-and-branch a measure, that it does not, so much as in other joint diseases, enter into our calculation ; and yet we are sometimes forced into action by the very urgency of the symptoms and by the horrible sufferings of the patient. If such a patient have strongly marked lardaceous degeneration, or have already osteo-myelitis, is it justifiable, supposing any operation be done, to perform an excision? A continued suppuration, which for a time must follow hip-exsection in a child so diseased, will most certainly conduce to futher degeneration, will rather hasten death than prolong life ; while to cut through a bone in a part where the medulla is already inflamed, and to leave it in a suppurating cavity, is to court prolonged suppuration and failure. If, then, in such a case any operation be advisable, it must be amputation at the joint. I have on more than one occasion performed this operation with success when the patients have been far advanced in both the above-named maladies.

The last point to which I must refer is the period when passive movement should begin. This, however, cannot be fixed at any definite time after the operation, but must depend on the quantity of bone removed, the absence of osteo-myelitis, and the more or less rapid healing of the wound. If no more than half the great trochanter and all the neck have been taken away, and the other two circumstances are favorable, passive motion may begin between the twentieth and thirtieth day: the removal of some of the shaft of the femur, a non-healing wound, with plentiful suppuration, must delay such movement until the parts put on a more healthy appearance.

Case XCVI.—The case from which the photograph reproduced here (Fig. 83) was taken, is that mentioned at p. 276, Case LXVIII. The child is in that history described as having an abscess at the top of the thigh, outside the origin of the rectus muscle. The swelling seen in the engraving is the remains of that abscess, and has nothing whatever to do with the operation-wound, which is better seen in the next plate (Fig. 84). It is also to be observed that more than three-quarters of an inch of the femur was removed for disease after I had completed the section of the bone in my usual place. The after-treatment consisted simply of extension in an abducted position. The wound filled up very rapidly, and would have entirely closed had I not kept it open by a drainage-tube. The bone was quickly reproduced, and on the twenty-seventh day passive movement was commenced. On the forty-fifth day he could lift the limb a little from the bed, and a few days afterward I let him have a high shoe for the left foot, and crutches.

Four months after the operation the photographs were taken. He could, as Fig. 84 shows, flex the thigh on the pelvis without bend or twist of the loins ; he could also well abduct the limb, standing with the feet well apart. I now regret that I did not have him photographed also in that posture. There is, as is evident on looking at Fig. 83, no shortening —a fact attributable to keeping the limb, during after-treatment, abducted.

Such are the results we should endeavor to obtain after excision. I have had many such cases, nor is the proportion larger for those that I have performed subperiosteally than for those carried out in the manner indicated at p. 423. Avoidance of osteo-myelitis, abduction during after-

treatment, and passive motion as early as possible, are the elements of success.

Excision of the knee-joint was, in 1860, when the first edition of this treatise was published, an almost new operation, or rather, like many novelties, was a revival of an almost forgotten method.

Mr. Filkin, who in 1762 first performed, and Mr. Park, who in 1782 first published an account of excision of the knee-joint, had more imitators abroad than in England, till within the last twenty-five years, and now their conditions are exactly reversed. Park operated again in 1783, but unsuccessfully. No one followed his example in this country till 1823, when Sir P. Crampton excised a knee, cured his patient, and a second time

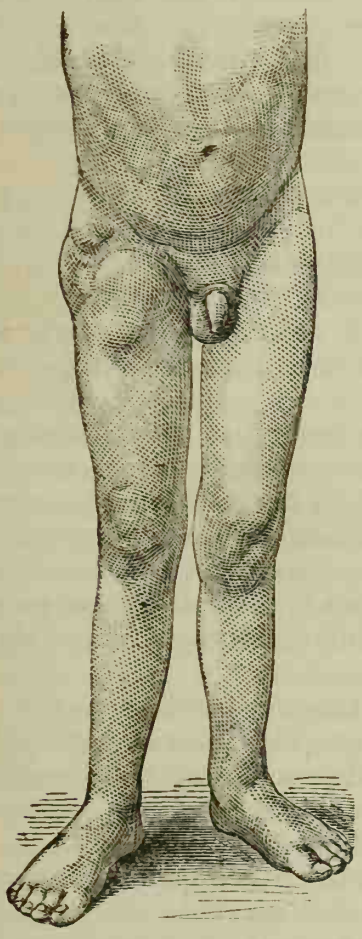

FIG. 83.—After hip-joint excision. No. 1.

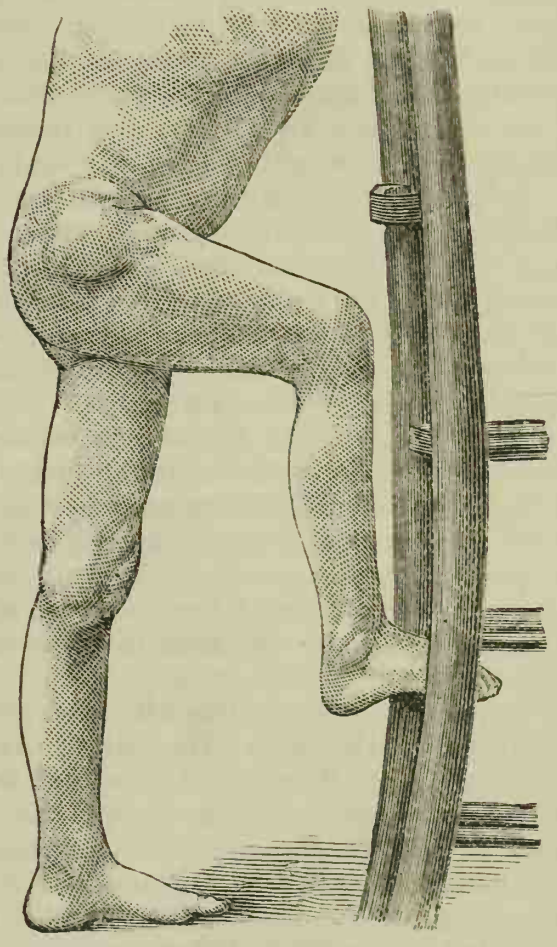

FIG. 84.—After hip-excision. No. 2.

was less successful. In 1830 Mr. Syme performed the sixth operation that had been done in Britain. From 1830 to 1850, when Mr. Fergusson revived the procedure in this country, it was not once attempted. Its fate, however, had been different abroad. Moreau père took up the method, and imparting his zeal to his son, they performed among others three excisions of the knee.[1] In France, however, a check was here experienced to its progress. In Germany, Mülder, who had operated in 1809, found no successor till 1821, when Textor, of Wurzburg, began his career, and in twenty-one years had excised five knee-joints.[2] In 1850 Mr. Fergusson

[1] The father two, 1792. The son one in 1811.

[2] For some of the earlier particulars of this operation I must refer to Mr. Butcher's Memoirs in Dublin Medical Journal, to Mr. Price's Essays of Excision, to Paul's Conservative Chirurgie, and many other works, as well as to the first edition of this treatise.

revived this operation. The patient died on the ninth day, apparently of purulent infection. But the discouragement which might have been produced by this case was obviated by Mr. Jones, of Jersey, who was sufficiently bold to try the procedure six months afterward, with perfect success; and again four months later; his third patient (September 4, 1851) died of diarrhœa, followed by dysentery. Since that time the operation has been performed frequently, both in London and in the provinces. Its results as to mortality may be stated with tolerable accuracy, but the ultimate benefit to the patient cannot be so perfectly ascertained.[1]

These last words, though written so long ago, are still to a certain extent true. Firstly, as to mortality, I quoted twenty years ago all the then available cases and their results, namely, 181; whereof 122, viz., 67.4 per cent., recovered; 59, *i.e.*, 32.6 per cent., did not recover; whereof 21.2 per cent. died, and 11.4 required amputation. Since then the method of operating, and more especially the after-management, has greatly modified these conditions, and I find the mortality, in the six London hospitals already quoted, exactly twelve per cent.

In military surgery the results are far less satisfactory. Thus, Gurlt gives for the German wars 96 cases, of which 78 died, that is 81.15 per cent. In the American Surgeon-General's report[2] eleven cases are recorded: one of these, as Professor Otis remarks, is doubtful; there remain then ten cases, of which one only recovered, a mortality of ninety per cent. But Gurlt gives for the American wars twenty cases, with three recoveries, or a mortality of eighty-five per cent.[3]

As to the number of cases in which amputation must subsequently be performed, data are less available, nor is the available information accurate enough for other than approximate numbers; as far as can be gathered, about six per cent. (civil surgery) have to undergo the further operation. My personal experience is that, of my thirty-nine operations, one had to undergo amputation, and I have one case in which no synostosis has occurred; but the limb in a proper instrument is very useful, and the girl walks about with ease.

In military surgery the ultimate results in the recovered cases are, according to Gurlt, these: He gathers, from all wars, thirty-three cases of excision for gunshot injury; of these, in twelve only could results be verified; one (left without after-treatment) was subject to amputation; 7 results were very good; 4 good; 10 out of these 11 with perfect synostosis.

The object of the operation is to remove the lower end of the femur and upper end of the tibia (generally also the patella) in such wise that the truncated ends of both bones shall form flat surfaces at right angles to the axes of the limb, so that when they are accurately coapted, the femur and the tibia form one straight line.

In operating, the shape of the flap is of little consequence, as long as a sufficiently depending opening be secured; yet it is always better to attain the object in view with the least damage to soft parts as possible. I prefer the following mode: Placing the left hand at the back of the joint, so as to grasp the inner and outer hamstrings with the finger and thumb respec-

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[1] Amputations of the thigh for all causes in the same hospitals bear a mortality of 31.0; pathologic amputations, of 25.5 per cent.

[2] Circular VI., p. 60.

[3] Gurlt appears to have records to which I have no access. It is clear that the War Office Circulars do not contain by any means all the cases of excision during that war, and until the remaining volume of the Surgical History appears, we shall have but partial data.

tively, on an exact level with the junction of the bones, I sweep the catlin across the front of the joint, below the patella, from pollex to index. This cut divides all the structures, the ligamentum patellæ among them, down to the joint in front, and exposes the lateral ligaments on each side. The upper flap is now reflected, together with the patella (which is to be removed, if at all, in this stage of the operation), far enough, as one judges by eye, to allow the ablation of a sufficient slice from the femur at right angles to its axis. Then the lower flap must be turned down a very little way from the front and sides of the tibia. Much bleeding and unnecessary complication of the wound is avoided by keeping the knife close to the bones. The lateral ligaments are then to be divided, and now the joint is to be bent. The procedure of the next phase depends upon the form of disease. The joint may still be a cavity filled with pus and dendritic growth, when it bends quite easily. There may on the contrary be spots of anchylosis interspersed with caries or scattered fibrous bonds, preventing flexion. In the one case, if the use of a little extra force do not overcome the difficulty, a chisel, on the other the knife, must be used; in either case one may cut securely toward the back of either condyle, but when opposite the intercondyloid notch great caution, lest the popliteal artery be wounded, should be employed. Letting now the limb be completely bent, so that the segments lie parallel, the surgeon decides upon the place where he will saw the bones, and draws his knife round both femur and tibia at that level, lest any soft parts, that may be brutalized by the teeth of the saw, remain. The section with the saw is that part of the operation which requires the greatest nicety. The direction of the cut must be at an exact right angle with the shaft of the bones, both in the lateral and antero-posterior direction, otherwise when the surfaces are coadapted either the limb will not be straight, or the surfaces will not be in contact throughout. Also, if the subject be young, it is very essential not to remove the whole epiphysis of either bone, chiefly of the femur; it is better to err by too little than by too much. I need hardly repeat my caution about the popliteal artery: it lies in the inter-condyloid notch, and bone that lies behind its level must be sawn through. This is best done thus: When holding the instrument straight it comes to the level of this notch, its direction must be changed to nearly an antero-posterior one, *i.e.*, handle in front, to saw the one condyle, then altered again tip forward to saw the other; afterward it is to be restored to the original straight position, when a little twist upward will snap off the thin shell of bone that remains. If it be found that too little has been taken away, and that another slice must be removed, it is better to do this from the tibia; sometimes bevelling down the posterior edge will enable one, without further shortening the bone, to get the sawn surfaces together. This should always be done at once, to test if the truncation have been accurate. At the same time the position of parts in relation to the outfall must be ascertained. This is best done when the bone-junction is half-closed. Afterward the sawn surface must be thoroughly and carefully examined, and the gouge freely used if disease exists; or, if this be too extensive or reach too high, amputation may be substituted (p. 402). This resection should not be accompanied by much bleeding, but if the disease have been severe, the enlarged articular arteries spout smartly, the external-superior giving the most trouble. In some cases the femur bleeds considerably from the whole sawn surface; this is a very difficult hemorrhage to stop. A piece of ice wrapped in a cloth passed over the surface will sometimes be of avail, or one may dip the cloth containing the ice in powdered alum or Ruspini's

styptic, tannic acid, or other astringent. If no measures will stop a rather free bleeding, amputation through more solid parts of the bone will probably be wiser than to continue the excision, as a quantity of coagulum between the bone-ends is a great obstacle to synostosis.

When bleeding has ceased, the surgeon should generally, indeed always, if there be much suppuration about the joint, make a better outfall for pus and wound secretion than is generally afforded by the horns of the wound, or by a tube passed through them from side to side behind the bone; for the hamstring tendons generally lie (in the recumbent posture) above the floor of the wound-cavity. The best mode of procuring a depending opening is to pass a scalpel, followed by an armed probe, through all the structures at the back of the joint between the artery and the external popliteal nerve, above the inferior articular artery of that side. By means of the thread a drainage-tube is to be drawn into the gap. After this the wound may be closely sewn with wire, except the two lateral horns, which, even with the drain just described, had better be left a little open.

The caution just given concerning the lower epiphyses of the femur is of very considerable importance. Mr. Syme was the first to point out that, after excision of the knee, the growth of the two limbs did not continue equal. But Mr. Butcher repudiated the idea that the operation could affect the growth of the limb. Some papers, however, by Mr. Pemberton[1] gave the details of a case which set the matter at rest. I subjoin a copy of Mr. Pemberton's illustration, and some comments I made at the time,[2] which throw upon the matter all necessary light,

"In the case which Mr. Pemberton quotes, as the first in which he had excised the knee-joint, an unusual quantity was removed from both bones. There is no doubt that the epiphyses were taken away. I have had no opportunity of examining the case itself, but Mr. Pemberton gives a woodcut, which we must presume to be accurate. On comparing carefully the length of the two thighs, and of the two lower legs, I find that the difference between the two former is, as nearly as possible, double the difference between the two latter. It is to be observed that both femur and tibia have an epiphysis at either end: those of the latter bone are horizontal and parallel; the growth in length of that bone takes place at both ends; hence, when its upper epiphysis is excised, it has still one end from which it may grow. But the upper epiphysis of the femur is very oblique, almost perpendicular, and growth from that end only takes place by the little that may be added to the length of the neck, and even that little in an oblique direction. Growth in length of the bone is, therefore, effected almost entirely from the lower epiphysis, and this is doubtless the reason why that epiphysis should remain longer ununited than any other in the body. When, then, this part is excised, growth in length of the femur must be very small. Hence, in Mr. Pemberton's case, the femur has lost double as much of its length as the tibia: if my measurement from the woodcut be correct, the femur will have lost six inches, the tibia three.

"These observations are greatly confirmed by the letter of Dr. Keith. In the cases there mentioned equal portions were removed from the femur and tibia; in a little more than three years afterward the measurements are these: Healthy femur and tibia, each, 17 inches; operated femur and tibia, 12½ and 14½ inches respectively. One loses 4½, the other 2½ inches,

[1] British Medical Journal, November, 1859.
[2] Ibid., December, 1859.

which follows sufficiently closely, within one-sixth of an inch, the law of double loss of growth from the femur."

Thus it is evidently of extreme importance to preserve the epiphysal junction in all patients below eighteen years of age. The operator must, however, be aware that the anterior part of the joint is by far the highest

FIG. 85.—Shortening after excision of the knee.—(From Mr. Pemberton's paper.)

point of the epiphysis, and if he saw off the bone in a line with the upper termination of the cartilage in this aspect, he will have removed the whole, and more than the whole joint-end. He must look at the side of the joint to find where the epiphysal junction takes place. It is just below the at-

tachment of the internal lateral ligament, on one side ; below the origin of the popliteus on the other.

The object of the after-treatment is to keep the bones in absolute immobility until they become cemented by firm bony union—synostosis. To carry out this, many forms of splint have been invented ; that which appears to me to fulfil this object with most certainty, at the same time permitting access to the joint, is one which I some years ago contrived, borrowing part of the idea from Dr. P. Heron Watson. A metal gutter, hollowed to fit the back of the thigh, and whose upper edge is oblique, to correspond with the fold of the nates, reaches from that part to about two inches above the bend of the knee, another such gutter supports the calf—commencing two inches below the joint to just above the malleoli—these portions are connected together by interrupting bars which project considerably back from the splint, so as to leave ample room to pass a bandage between them and the limb. At the bottom of the leg part the metal gets narrower, and is very much prolonged, so that when bent it sweeps round, but a long way from, the heel, and terminates in a broader sole-piece. The suspension-rod of Heron Watson is the only other part of the appliance except bandages and plaster-of-Paris. When the operation is complete, the leg—up to the antiseptic dressing—is smoothly enveloped in a flannel

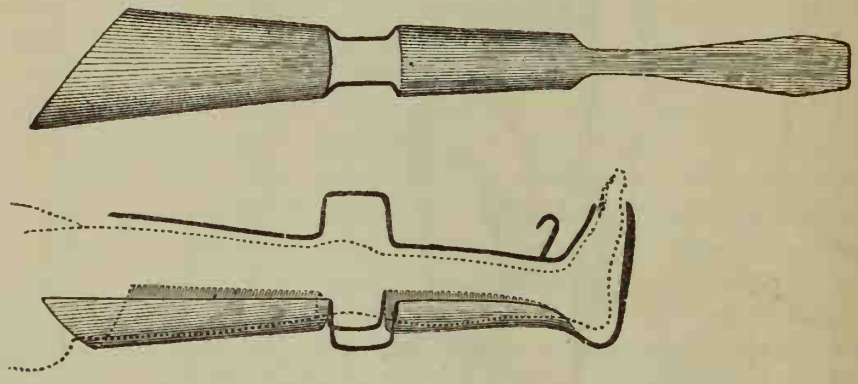

Fig. 86.—Splint for after-treatment of knee-excision.

bandage, then the thigh, from this dressing upward, is similarly treated. Afterward the limb is laid upon the splint, smoothly and softly padded, while every point where pressure might fall is examined, and if necessary rectified. When all is satisfactory the splint is bandaged on with flannel, then the suspension rod is held over the limb, a fold of lint put under the bend at the ankle, and along the foot, another above and below the knee at the angles, a fourth at the end, in the groin ; care must be taken that this part be not too long. Lastly, the whole limb from the toes upward, save four inches or more about the wound, is swathed in a close-fitting plaster-of-Paris bandage. As soon as the plaster sets, the patient is conveyed to bed ; but it is better not to hang the limb by the rod for twenty-four hours, *i.e.*, not until the gypsum is quite hard ; in the meantime it may be suspended from the cradle by loops of bandage passed under the limb and splint.

It is really singular how little patients suffer after this operation, if the limb, supported on all sides, be thus completely immobilized, and inflammation prevented by antisepticism. I have had many cases perfectly free from pain, from the first six hours of the operation. The dressings un-

der the spray are cut away and reapplied without moving the limb or unhooking it from its suspension. In fact there is nothing for the patients to do but to be still and get well, most of them. I have at this moment a young lady who has done so, got fat and strong, after having been worn and emaciated.

A few words must be said concerning the patella. Of course this bone, if largely diseased, must be removed ; if less diseased, it may be gouged, or its posterior surface may be cut away,[1] if healthy, it may be removed or left, as the operator may choose. But the choice, if it is not to be mere caprice, must be somehow guided. The points to be considered are these :

For healthy patella.—Does the presence of a healthy patella in any way

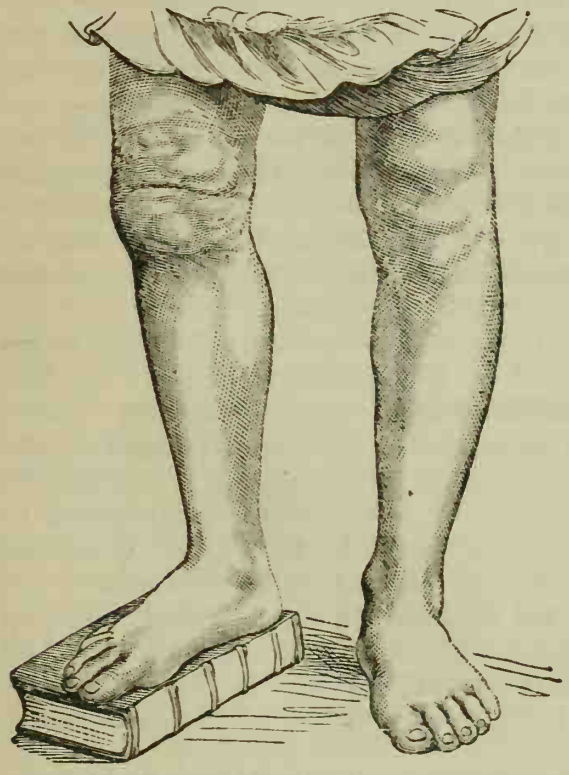

FIG. 87.—Excision of knee. Much bone removed ; patella left.

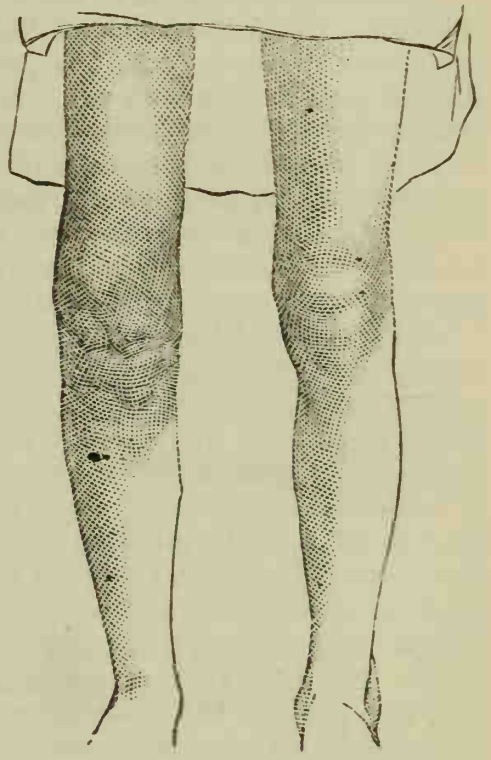

FIG. 88.—Two months after excision.

endanger the success of the operation? Does leaving the bone *in situ* procure to the patient any advantage, immediate or subsequent?

For diseased patella.—What amount of gouging or resection may be done? Will the bone sustain it without danger of necrosis or caries?

The answer to the first question is, in my experience, this. If the patella and its cartilage be healthy, its presence in no wise endangers the entire success of the operation, provided that in order to retain it no unusual quantity of hypertrophied and encroaching synovial folds be left.

The second reply must be in the affirmative. A certain, though perhaps not very important, advantage is obtained in the better appearance of a limb in which the patella is left. For instance : Jane L., aged seventeen, full grown, for whom, in 1872, I removed the knee-joint, leaving the healthy patella behind, has a far more shapely limb than could have been procured had I, together with the large amount of femur and tibia I had to take away, also removed the patella (Fig. 87). Another and more appreciable benefit is in the greater strength of the limb, which I think is pro-

[1] A special pair of cutting pliers are manufactured for the latter purpose.

cured when this bone is left. In all such cases, eight in number, the resultant limb has been particularly strong.[1]

The two figures on page 439 contrast favorably in appearance, so far as the mere outline of the joint is concerned; but in John M., aged fourteen, I obtained extremely rapid union, with very little suppuration and without a bad symptom; indeed, from the moment of operation, the health, which previously had been much implicated, began to improve. The photograph was taken two months after removal of the splint; both thighs are therefore wasted; their appearance a year afterward was very different. The very small, indeed almost the absence of, shortening is here to be observed; the lad walked remarkably well.

Failure after excision of the knee may be immediate, consecutive, or subsequent. The causes of immediate failure are those that occur during the operation. They may be too great extent of disease, chiefly of bone; or abscess reaching too far away from the joint, either in the bone or soft parts; excessive bleeding or oozing, either from the sawn or cut surfaces. In the two first events the surgeon will decide how the operation must terminate, according to the principles already laid down (p. 402). In the third contingency he must be guided by the general principles of surgery, and by the fact that bones, which bleed considerably after they have been juxtaposed, do not, as a very general rule, unite by synostosis.

Consecutive failures I define as those which occur during the after-treatment. They may arise from local or constitutional causes; the former are excessive suppuration—continuance of caries and necrosis[2]—non-union of bones. In the first series of cases the surgeon frequently must estimate the desirability of future proceedings by comparing the condition of health with the local state, by observing whether the suppuration at the wound tend to increase or to decrease; and by thus forming conclusions, according to the general principles of surgery, as to whether the patient can outlive and overcome the local tendency to suppuration, and as to whether amputation will improve the condition. In the second series he has to study the state of matters in the same way, and furthermore must take into account the possibility of mere local removal by gouge or chisel of the necrosed or carious spot.

The third cause of consecutive failure results from flexible union between the bones instead of an immovable synostosis; such a termination, after weeks of lying still, is most disappointing to the patient, as also the surgeon. The causes of this defect are, to a certain degree, the same as those of non-union after fracture in a young and non-syphilitic person; the chief being want of sufficient quiescence. But there are other sources of the ill-result: one of these is too large and free suppuration; the other, bleeding from the bone-end after the limb has been secured and dressed. The first of these may be eliminated by using the metal splint and plaster-of-Paris band above described (p. 438). The second is often obviated by operating antiseptically, and mopping out all abscesses at the time of operation, and even for some days previously, thoroughly injecting the sinuses two or three times in the twenty-four hours with carbolic acid.[3]

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[1] Deductions from small numbers must be cautiously drawn and very cautiously accepted. I cannot affirm that the limb-power is in these eight cases due to non-removal of the patella; a larger number of carefully recorded events is wanted.

[2] Such conditions as are common to all operations, viz., secondary hemorrhage, sloughing, shock, etc., are here omitted.

[3] Since I have performed my excisions by this method, suppuration has been very trivial in amount and healing most rapid, except where I purposely kept up a strain.

The third condition is much more difficult to deal with ; the procedure depends on the amount of bleeding and our possible control over it.[1] If it be considerable, and will not yield to fairly mild measures, it will probably be better to amputate, for strong styptics might easily induce necrosis or caries after reposition of the limb. If the bleeding can be controlled—more especially if cold, which can be kept applied when the bones are *in situ*, check the flow—we may retain the limb.

If the surgeon find, when he permits his patient to get up, an entirely loose tibia—a flail-joint—he may hesitate whether or not to amputate the limb, whether to re-excise, or to leave it and trust to instruments. I would recommend, in the first place, some patience, the use of a plaster-of-Paris splint, strengthened by strips of tinned iron, placed laterally ; for it does not of necessity happen that a limb thus loose is absolutely useless. In 1876 I showed at the Chemical Society—

Case XCVII.—Anne B., aged nine, whose knee had been excised three years previously by Mr. Cowell. When the child sat or was recumbent, the leg hung quite flaccid and apparently useless, from the femur there was a "flail-joint." But when she was put on the floor and told to walk, she started off quite well, going with only the amount of limp that the shortening demanded. She did not use a stick, nor even grasp the thigh, in the manner so often resorted to by those who have a weak limb. Indeed, the child had evidently perfect confidence in the security of the joint. The limb was at the time more useful than one in which synostosis has occurred. The anatomical condition appeared to be as follows : It is, of course, to be presumed that the bones were cut off quite straight, but the original line of section has changed its form, the femur having become rounded somewhat from before backward, so as to form a species of trochlea, with the axis from side to side, while the end of the tibia has hollowed itself into a sort of sigmoid notch. The line of this false joint may at either side be traced running from before backward and upward, for the tibia is displaced somewhat backward, its axis lying rather behind that of the femur. The fibula is displaced from its normal position, and lies more completely behind the tibia. It is somewhat prolonged upward, or, to speak more strictly, the tibia, having lost its upper epiphysis, has grown less than the normal, while the smaller bone, remaining entire, has continued its natural ratio of growth ; hence its upper end projects considerably higher than the tibia ; to it is attached a particularly strong and well-developed biceps tendon.

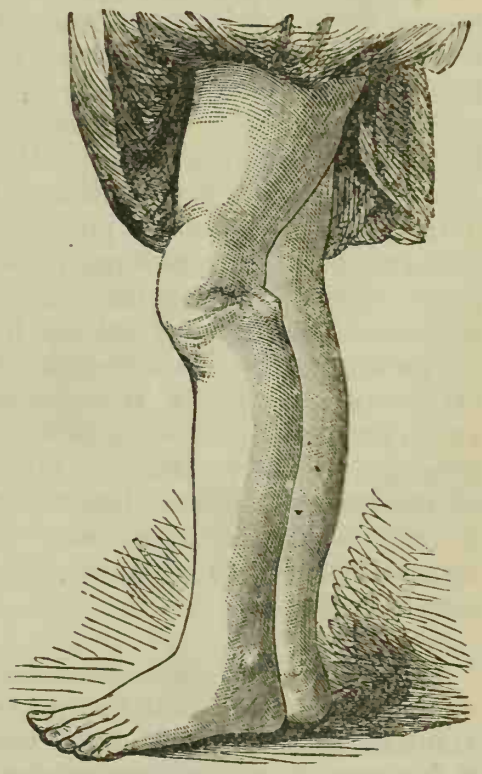

Fig. 89.—Unusual condition after excision of the knee.

[1] No joint-excisions should be preceded by the use of an Esmarch bandage, as that appliance certainly conduces to bony oozing.

Knitting together and surrounding the bones is a strong, but rather thin capsule. Running from the upper end of the fibula downward to the lower and front part of the end of the femur, so as to support it as in a sling, is a very strong cord-like ligament. No other ligamentous structure can be felt, but, of course, there lies between femur and tibia, after the manner of an interosseous ligament, strong fibrous bonds ; and doubtless an arrangement exists whereby a sort of interlocking of parts takes place, giving to the false joint sufficient firmness to support the body. The chief agent, however, is the fibulo-femoral cord. The child at the date was small and light, and it is questionable whether, as she grows heavier, the joint will still be able to uphold her.[1] I have since that time observed a tendency to yield outward, and in 1878 put on an instrument with a hinge, to prevent lateral bend, and at the present date the child uses the limb extremely well.

In another instance—that of a girl aged seventeen—and who turned out to be a hæmophilic—I had great difficulty in checking hemorrhage. No union took place. I tried all the usual means of treating non-union, even to ivory pegs, but in vain. She wears a splint, and declares that her leg is very useful, and nearly as good as the other.

Subsequent failures are such as arise when the patient has been dismissed from care some months or years, with a limb which perhaps is perfectly firm and straight, which yet, after a time, presents some damning defect. One of these, considerable and increasing shortness, has been already discussed (p. 436). Another is return of caries, with abscess more or less large, in the neighborhood of the operation-wound. Sinus-mouths leading into scar or other fibrous tissue, weeping, rather than discharging, each day a drop or two of serous pus, remain open very frequently for two or more years after excision of large joints. Their inconvenience is so small that it is not advisable to cut into them or probe them often ; they heal generally of themselves, and the quicker if left undisturbed. But the conditions are different if, after some months or some years, fresh openings form and increase in quantity, if parts around the healed bone-wound inflame and swell, and if the sinuses, instead of leading to mere soft tissue, let the probe impinge on soft mortar-like bone. If this state of parts occupy a large part of the junction, it may be necessary to re-excise, or, since a fresh failure is probable, rather to amputate. If the carious condition be limited, a slight, or even a free, use of the gouge may effect all that is necessary. Such a case is that of

Case XCVIII.—John C., from whom the figure on opposite page is taken, when (November, 1860) in the Charing Cross Hospital, whose knee-joint Mr. Hancock removed in March, 1858. During recovery he had two attacks of inflammation, ending in abscesses, one inside, the other outside the uniting bones. However, in the thirteenth week the wound was healed : at the end of the fifth month he was discharged. He has been working as a gardener since, and found the stiff limb extremely useful in driving down the spade. Eight months ago he had an attack of pain, which caused him to take to his bed. In ten days this ceased, and he went to work again ; but, in six weeks more, pain returned, and has been recurring at shorter and shorter intervals. Rest after a time did not suffice to still them. He returned under Mr. Hancock's care May 5, 1860, complaining of these almost constant pains. There was a sinus both inside and outside the new union.

[1] Clinical Society's Transactions, vol. ix., p. 173.

The influence of counter-irritants, of rest, and a diet better than what he had been accustomed to, was tried, and for four months he appeared getting better. However, pain returned. On examining the sinuses they were found to extend through the thickness of the limb, but no rough bone could be felt.

November 23d.—It was thought advisable to cut down and find out what was the condition of parts. The mass of tissue which formed the scar at the outside of the limb was very thick and tough; the finger entering into the wound at this place passed behind the lower end of the femur, which could be felt firmly united to the anterior part of the sawn surface of the tibia; the posterior portion of this surface was bare, rough, and carious. The gouge was freely applied, and all that could be felt diseased removed.

The man recovered soundly, and was quite well when I last saw him, February, 1865.

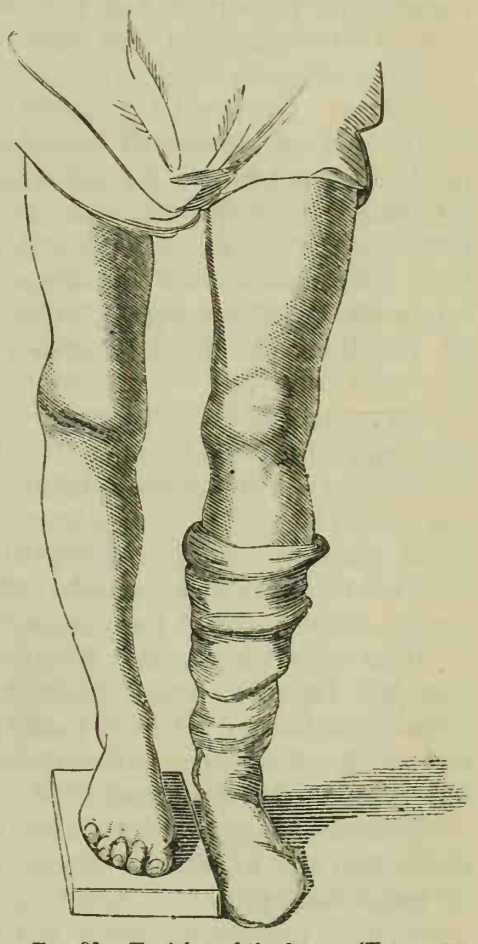

FIG. 90.—Excision of the knee. (Two years after operation.)

Another cause of subsequent failure is bending of the union. This generally takes place outward, but also in the direction of flexion. I came across a case—not my own—four years ago, in which hyper-extension was the unusual posture assumed. This bending happens in cases which to the hand are entirely stiff and immovable, even though considerable force in the investigation be used. The mishap is in very great part, if not altogether, owing to the patient's neglect, since, if the surgeon's aid were sought as soon as some yielding at the place of operation were detected, suitable means—either an instrument formed by a steel rod on each side of the limb, united by curved back-plates, and in front by straps, replacing the bones, or applying plaster-of-Paris bandages, firm leather or poroplastic splints, these bends can always be checked.

If the patient have foolishly neglected to seek aid, such condition as in Case LXXIX., p. 373, results, and may be similarly treated; as even now I am treating a lad, aged sixteen, whose knee I excised four years ago; it was bent at about 135 degrees. Osteotomy, a little above the old seat of operation, has again straightened the limb, and he is doing perfectly well.

Excision of the Ankle-Joint.—Cases to which this operation is applicable, though not very common, are yet sufficiently frequent to afford very many examples of its value; indeed it is one of the most satisfactory of surgical procedures, and has in my hands yielded a brilliant return for the care and trouble expended in the treatment. The operation was first performed by Moreau senior, in April, 1792, and by his son in 1796; and again in 1815. Afterward, by Mülder in 1810, and Champion in 1813. I am not aware of its having been repeated after that date, and certainly it was never performed in England until Mr. Hancock introduced it into this country in

February, 1851. Be it observed, that excision of the ankle-joint means the removal of those parts only which enter into the formation of the joint. Of this operation Mr. Hancock says,[1] in his well-known Lectures at the College of Surgeons: "Attempts have been made to deprive me of its introduction into British surgery; but there is no doubt that this merit belongs exclusively to my late colleague."[2]

The statistics of the operation are, owing to the restricted number of fitting cases, not very full: in the ten years of hospital practice already so often quoted, are 47 cases; of these, 6 died, a percentage of 12.6. It does not appear that any such operation was performed during the American War; but the history by Otis is still incomplete. Gurlt gives,[3] when a number of partial and of larger excisions are eliminated, 55 cases: the result of 1 is unknown; 19 died; giving a percental mortality of 35.1.

The ultimate results of the cases in the six London hospitals are not traceable. Of the 13 patients on whom I operated, 2 died—one a syphilitic patient, of persistent consecutive hemorrhage, one a child, of tubercular meningitis; 1 had a merely fibrous anchylosis—I saw her for three years afterward on different occasions; by means of a steel instrument running half-way up the leg, she was able to walk very well—10 had perfect synostosis with the foot at right angles to the leg, and were able to walk well when leaving the hospital. Gurlt gives, of the 21 cases he was able to trace, 11 results as good—3 of which are very good; 9 as fairly good; 1 as not good.

In selecting cases that are fit for this operation, the surgeon must make quite sure that the bones of the tarsus are sound, or, if the astragalus be involved, that the disease lies on or close to the trochlear surface; he must also ascertain that the calcaneo-astragaloid joint is healthy. If sinuses exist, their direction and depth will aid in the diagnosis; if no openings lead to diseased bone, more difficulty will be encountered; but such cases rarely, if ever, call for excision.

The operation as described by me is thus performed. I will only say that Mr. Hancock was always in the habit of connecting the lateral incisions here described by a merely cutaneous one passing across the front of the joint. I never saw the value of this connecting cut, and in all my own operations have suppressed it.

The object of the operation is to cut off the upper surface of the astragalus and the lower one of the tibia, without dividing any tendons, nerves, or important vessels. The foot is first laid on its inside, and an incision is made over the lower two or three inches of the posterior edge of the fibula. When it has reached the lower end of the malleolus, it forms an angle, and runs forward and downward to within about half an inch of the base of the outer metatarsal bone. The angular flap is reflected forward; the fibula, about two inches above the malleolus, is sufficiently cleared of soft parts to

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[1] Anatomy and Surgery of the Human Foot, p. 274.

[2] Writing, as I am, when the body of my friend has been just borne to its grave, I cannot help animadverting upon the latest attempt of this sort. It occurs in a paper in the Medico Transactions, vol. lvii., p. 137—the author of which, unwilling to allow and unable to deny to Mr. Hancock his just meed, calls the procedure the "Holmes-Hancock operation. When the paper was read I pointed out this error, and that Mr. Hancock's operation was performed before Mr. Holmes was a surgeon; nevertheless the author, who at the time acknowledged his mistake, allowed the misnomer to appear in print. Mr. Holmes himself by no means sanctions this nomenclature, and indeed, in describing the operation, takes my account of it as it stood in my first edition.

[3] Loc. cit., p. 1278.

allow of cutting forceps to be placed over it ; the bone is then nipped in two, and carefully dissected out, leaving the peroneus longus and brevis tendon uncut. The foot is now to be turned over. An incision similar to the outer one is made on the inner side of the foot, terminating over the projection of the scaphoid bone. The flap is to be turned forward, and the sheath of the flexor digitorum and posterior tibial tendons divided, the knife being kept close to the bone, avoiding the artery and nerve. The internal lateral ligament is then to be severed carefully, close to the bone ; and now the foot is twisted outward, and the astragalus and tibia will present at the inner wound. The surface of the tibia is cut off with an amputating saw. An assistant grasps the foot by the heel and instep, and makes extension downward ; this gives ample room to introduce in front of the tendo Achillis a narrow saw with which the trochlea of the astragalus is removed from behind forward. The only vessel which may require tying is one of the lower branches of the peroneal artery.

The surgeon may meet with one or two difficulties which are not here noted. In clearing the fibula the peronei tendons should be spared. This is easy ; when their sheath is divided they are held back by a blunt hook ; the knife, kept close to the bone, is carried down along its back, swept round the malleolus, its flat resting on that process, its point on the lateral surface of the astragalus, is carried upward in front as high as the upper angle of the trochlea. When the fibula is bitten through by the bone-nippers, if it will not come away of itself, the interosseous membrane, and the still stronger ligament of that name, must be divided thus—the peroneal tendons being still held out of the way, the blade is passed downward along the inner side of the fibula, and close to the bone, to the point. A scalpel curved on the flat may be of assistance here.

Next, and in regard to the tibia—the parts most internal on that bone are easily separated—if the disease be so far advanced as to have destroyed or weakened the posterior ligament of the joint, the foot will luxate without difficulty ; but if, as is perhaps more common, this be not the case, it will be impossible to effect the displacement without the division of those fibres. A retractor must hold the two tendons, the artery and nerve, back, while the surgeon, passing his finger in front of them, uses it to guide his knife to the flexor longus pollicis, while the sheath, being incised, is also caught and held back. The edge is then turned forward, and while being withdrawn from the wound, severs the whole ligament, after this the foot dislocates very readily. The operation, although not easy, presents to skilful hands no great difficulty, nor do I see how such a modification as is proposed by Mr. Lee [1] can for a moment be considered an improvement.

When the saw-cuts have been completed the section surfaces must be carefully examined, and any diseased portion removed with the gouge, if it be small. If, on the contrary, the astragalus be widely and deeply affected, a larger slice of less regular form, *i.e.*, running deeply into the bone at the place of disease, should be taken away. If this still be insufficient, the whole astragalus must be ablated, and this should be done subperiosteally.

As to performing excision of the ankle-joint by the subperiosteal method, the same may be said as for that mode of excising the knee, with this difference, that the fibula may advantageously be shelled out of its investing membrane when it is possible to do so ; but the bone is rarely inflamed as high as the point at which it must be divided, and very generally, under such circumstances, it is simply impossible to detach the periosteum from

[1] Medico-Chirurgical Transactions, vol. lvii., p. 1377.

a bone with so many surfaces and angles as the fibula. To peel the periosteum from the tibia is useless, or worse than useless ; from that bone only a thin slice is to be taken, whose regeneration we do not wish for. Therefore, to leave an edging of loose periosteum hanging about the junction, is to court uncomfortable deposit of irregular bone in a highly inconvenient place. Moreover, as we want and obtain synostosis of the two truncated bones, the lateral ligaments are not valuable, and we may, without compunction, divide them. No one has greater respect for Mr. Ollier's valuable discovery, no one is more ready to make reasonable use of it than I; but the mere fashion of the day should not stand in the stead of common sense and experience.

The after-treatment of excision of the ankle is, like that of the knee, perfect rest and entire immobility of the part. The splint which I use is a metal gutter for the front of the leg and the instep ; as the metal is already bent laterally to fit the rounded front of the limb, it cannot at the junction of leg and foot also take the back and forward bend ; a stout wire must therefore be brazed along its length, while the gutter in front of the malleoli opens at each side and is greatly narrowed. The foot-piece broadens out again and accurately fits the instep, while the wire is prolonged about an inch and a half farther, so as to project, in the recumbent posture, horizontally. All this having been prepared, the wounds are stitched at either end, but left open in the middle, drainage-tubes being thrust through them from side to side. The antiseptic dressing is then applied, the splint adapted to the limb, and the whole enveloped in a firm, but not too thick, plaster-of-Paris bandage. It is a good precaution to place a ring-shaped pad of wool, or, better still, of horse-hair, under the heel. While the plaster is drying it may be marked with some pointed, not sharp, implement, exactly opposite the two wounds ; and at these points windows may be cut before the gypsum has become very firm. Adult limbs are large enough to allow of two openings, separated by a bridge of the bandage, corresponding to, but broader than the tendo Achillis. The ankles of little children are too small for this arrangement, and all the back part of the plaster has to be cut away at the level of the wound. Now will be seen the use of that hook-like prolongation of the wire over the end of the foot-piece. The foot, being deprived of all firm bony attachment to the leg, is apt gradually to slip downward a little in the plaster, the sawn surface of the astragalus to glide backward on that of the tibia. To obviate this, I pass a plaster bandage under the heel, which is already carefully padded and protected, and, bringing it over the wire projection, sling the foot so that part of the splint—or two bandages, one for the leg, one for the foot, with an interval between them—may be used.

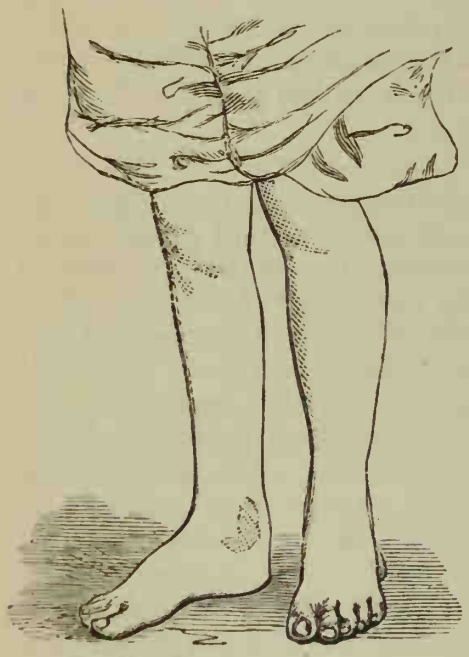

Fig. 91.—Excision of right ankle.

Ossification at this part takes place very quickly. I have, even though I knew of this rapidity, and pointed it out twenty years ago, been often surprised at the promptitude of cure. Nor can I perceive that a shred of

periosteum projecting beyond the cut edge of the tibia is of any advantage. Tardiness of the process depends (antiseptics having kept down inflammation and suppuration) upon constitutional causes, as great exhaustion from previous disease or tubercular diathesis.[1]

Of my eleven successful operations, all the results were very good (Fig. 91), that is to say, there was perfect and firm synostosis between the truncated surfaces and a barely perceptible amount of shortening, while after a little time the gait became, in most of them nearly, and in some of them quite, normal; in all of them the sural muscles were considerably wasted, particularly at first, but regained somewhat of their normal size afterward.

These last phrases require some explanation: since at the place, where formerly lay the ankle-joint, there is now no movement between tibia and astragalus, the foot cannot be flexed and extended as before; the patient has therefore a great tendency to walk with the foot turned a good deal out, so as to avoid the sort of jog upward that would arise if he were, with stiff ankle, obliged to rise on the toe in progression. This tendency must, however, be checked; and the foot, grasped by the instep and heel, must be subjected to pretty forcible passive motion, by the combination of which means the calcaneo-astragaloid, medio-tarsal, and other joints, become so flexible that they form excellent substitutes for the ablated ankle. Also at first, while stiffness continues, the calf-muscles, thrown out of employ by synostosis in the place of the ankle, diminish in size, or, if wasted from previous disease, do not, at all events, increase; but, as I have in more than one instance verified, they, though never becoming as well developed as if no disease had occurred, begin again as soon as movement between the astragalus and os calcis becomes pretty free, to increase in size and to regain to a considerable extent their normal form.

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[1] In one of my patients the union was greatly delayed, but I succeeded in obtaining it, and got the child about, though a small sinus remained. One day I found him in bed with a bad headache, sickness, and high temperature; in a day or two irregular contraction of the pupils was followed by coma, and in a few days more by death. The post-mortem showed abundant miliary tubercle in the meninges.

APPENDIX TO CHAPTER XIV.

ON THE ALLEGED OCCURRENCE OF REAL LENGTHENING.

Although most of our reliable English authorities affirm, that "lengthening of the thigh in hip-joint disease is merely the effect of the position which patients thus afflicted assume," yet some English, and many Continental (chiefly German) authors take a view so entirely opposite, and support their doctrine by so manifold reasons, that the subject has appeared to me as requiring further investigation.

Hunter conceived the "lengthening" to be due merely to position. Ford held the same opinion, although he has not expressed it very clearly, nor decisively. Brodie says, "This appearance is altogether deceptive, and on a careful measurement being made with a tape from the anterior superior spinous process of the ilium to the patella or inner ankle, it is found that there is no elongation in reality. The pelvis is inclined laterally, so that it makes on the side of the disease an obtuse angle with the spine."[1] Bonnet entertains an identical opinion, and explains at great length, the various positions whereby this deceptive appearance may be produced. On the other hand, Coulson considers that the limb may be really lengthened "a little more than an inch."[2] Erichsen[3] says, "Real elongation is not common, but may occur in consequence of effusion into the joint, and thrusting down of the head in acute arthritic coxalgia." This is a point on which it behooves us to be accurate, and I will quote passages from those whose authority stands high in England, and on the Continent, in order that a full view of the subject may be before the reader; only premising, that those who consider the thigh to be really lengthened, conceive that such elongation is produced by some morbid change, which causes the head of the bone to be partially expelled from the socket, and that then the weight of the limb causes it to sink down. Rust, of Vienna, ascribed this lengthening to swelling of the head of the bone, which forced it out of the acetabulum; he quite overlooked posture, considering the whole elongation to be real. Falconer, Boyer, Bichat, Desault, and others, consider the lengthening due to swelling of the articular cartilages. Petit was the first surgeon who supposed that an accumulation of fluid in the cotyloid cavity could separate the head of the femur from the acetabulum; and Sabatier seized upon this notion, and attributed the lengthening of the thigh to this cause. Fricke[4] assumed that a relaxed condition of the muscles might cause real

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[1] Sir B. Brodie, On Diseases of the Joints, p. 117.

[2] Coulson, On Diseases of the Hip, p. 10.

[3] Science and Art of Surgery, vol. ii., p. 310.

[4] Annalen der Chirurgische Abtheilung des allg. Krankenhauses in Hamburg, 2ter Theil, S. 29.

lengthening of the thigh. Sir B. Brodie says: "In cases of inflammation (acute) of the hip, if active treatment be not had recourse to in the first instance, there is always danger of the head of the femur being thrust outward beyond the margin of the acetabulum, and then completely dislocated by the action of the muscles. Several cases of this kind of dislocation have fallen under my notice."[1] Be it observed, however, that he does not attribute the lengthening to this cause. Boyer, Larrey, and others imagined that the lengthening might be produced by swelling of the ligamentum teres. A number of authors (Boyer, Larrey, Morgagni, Rust) put down swelling of the Haversian gland as one cause of the lengthening, and many agree with them, that a solid swelling pressing the head of the bone out of the cavity, may produce such distortion.

Upon the other side of the question we have chiefly Hunter, Brodie, and Bonnet, who consider the lengthening as due entirely to position. Let us now discuss whether any of the causes above enumerated can produce a real lengthening or shortening of the thigh.

In trying to determine this question two points must be made clear: first, whether any one of the causes mentioned is capable of pressing the head of the bone away from the acetabulum; secondly, whether, if the head of the bone be thus separated, the thigh will thereby be lengthened.

First Question.—That the head of the bone is very seldom enlarged, may be drawn from the fact, that Rust, who was the most zealous advocate of this idea, could only quote one case in which it was shown to occur. Fricke, of Hamburg, gives one in which some very slight enlargement was said to have taken place. I have not found any pathological preparation, in which the head of the bone proper, *i.e.*, the part ordinarily covered by cartilage, was increased in size. Swelling of the cartilage itself could, at the most, attain to one or two lines, and could not therefore cause lengthening of an inch or more. Effusion, or growth in the acetabulum, would then be the only causes remaining. It may very much be doubted, whether a liquid effused into the capsule of the joint would accumulate at all between the bones. The most part, as Bonnet observed, of his injections in the dead subject gathered about the neck of the femur, but some, he says, was between the bones; though how he ascertained that point he does not say; at all events, while the muscles maintain their integrity and action, liquid would much more easily distend the capsule than displace the bone. A solid tumor, as a growth of granulations from the bottom of the acetabulum, would be far more capable of making place for itself between the bone-surfaces, but it is to my mind very doubtful, whether it could press the head of the bone the least distance from the socket. Let the position of the two lesser glutei of the pyriformis, the obturators, gemelli, quadratus, and upper part of adductor magnus—the strength of all the upper and anterior part of the capsular ligament, be considered; and let it at the same time be remembered, that neoplasms do not push aside parts which are in any degree firmly fixed, but simply produce their absorption. Hence it appears, that none of these causes could operate in pushing the head of the bone from the socket. It is only due, however, to the high status of Edward Weber, of Bonn, to say that this opinion is diametrically opposed to his. The experiments whereby he seemed to show that atmospheric pressure keeps the femur in its place, have been already detailed (see p. 6); a corollary that he draws from them is worthy of quotation.

[1] Loc. cit., p. 54.

"We have seen in the experiments above described, that as soon as air was allowed to enter the cotyloid cavity over the caput femoris, the head fell out of the acetabulum, no change in the ligament having taken place. It is not necessary, to the production of this effect, that the substance should be air penetrating from without. It may equally well be a fluid accumulating there by secretion from the vessels, or a solid substance growing in that place. In the same degree in which such fluid or other substance forms and increases in the cavity, will the head of the bone sink by its own weight, out of the acetabulum, without the necessity of any pressure, and without encountering the smallest resistance from the ligaments."[1] Surely, even if this theory of synovial vacuum were as correct as it has been shown to be unfounded, such an ignoring of muscular action and ligamentous resistance cannot be admissible. The presence of either fluid or new growth would not destroy the vacuum, if any such existed, so that the new material would place itself where it encountered the least resistance, and that would certainly not be between the head of the thigh and the pelvis. Were the femoral head so loose in the acetabulum as Weber thought, we should all be dislocating our hips every few minutes. However, this assumption is best refuted by some experiments to be detailed below.

Second Question.—Let it be assumed, for the present purposes, that the head of the femur may be pressed outward by an internal force, will such change in position alter the length of the thigh? The direction of such displacement is outward, and a little downward, but so little in the latter direction, that it may well be questioned if a separation of an inch between the two surfaces would cause any appreciable difference in the measurements of the thigh, considering that the limb could not be dragged down by its own weight, until the head of the bone protruded beyond the lip of the acetabulum; and not even until the Y-shaped ligament was destroyed.

Experiment I.—May 4, 1860.—On the body of a full-grown man not emaciated; all the viscera had been removed, the thighs were forcibly flexed, extended, and moved in every direction, until all rigor mortis was overcome.

A needle was driven into the anterior inferior spinous process of the ilium, another into the femur, above and to the outer side of the knee-joint; an inflexible wand of wood was then procured, and at right angles to its axis a needle was driven into it; this was applied against the one in the ilium, and a fourth needle was inserted at the point of the wand, where it came in contact with the one in the femur. Most accurate means of measurement were thus procured, one whereby a variation in length to the $\frac{1}{100}$ of an inch could be appreciated.[2] The subject lying on its back upon the table, a hole was rapidly bored from the inside of the pelvis, through the acetabulum; the staff being held against the needles, showed no alteration in the length of the limb.

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[1] Einige Bemerkungen über die Mechanik der Gelenke, etc., Ed. Weber. Müller's Archiv, 1836, p. 57.

[2] The difficulty of measuring the thigh can hardly be understood by any who have not directed much attention to that subject. The obstacles which are encountered on the living, in comparing one side with the other, of getting the two thighs in exactly the same relation to the pelvis and at perfect right angles to the axis of the body, render measurement of limb against limb very difficult. Needles were chosen as fixed points because all processes of the bones are too broad to serve as accurate objects of measurement, and they were fixed into the bone because the mobility of the skin destroys nicety of appreciation.

Experiment II.—Same day.—On the other limb of the same subject, like means of measurement being adopted. On boring a hole through the acetabulum, no difference in length could be detected; the nozzle of a syringe was then fitted to the opening, and water was injected. About three drachms probably found its way into the cavity: no more could be forced in, although considerable pressure was used; there was no difference whatever to be detected in the distance between the needle in the femur and that in the ilium.

Experiment III.—May 9, 1860.—On the body of a man who died of old age. All internal viscera were removed, rigor mortis of left hip entirely overcome by forcible flexion, extension, etc. Needles driven in as for Experiments I. and II. The reverse surface of the acetabulum was pierced (measurement showed no consequent change in the distance of the needles), and enough of the bone was cleared away to permit the easy introduction of the tip of the little finger, wherewith the smooth head of the femur could be felt: synovia flowed. An iron screw-driver was inserted between the acetabulum and the head of the femur, and then turned, so as to lie with its greatest breadth between them; this visibly moved the trochanter outward, but made no difference in the distance of the needles. A wooden wedge was then driven between the two articular surfaces (the back portion) by successive blows of a mallet, till the mass inserted equalled $\frac{8}{10}$ inch. This caused visible projection of the trochanter; it was hardly possible to obtain any sufficiently accurate measurement of the amount of projection, since, from simultaneous rotation inward, the relative position of ilium and trochanter was altered. At all events it was known that a mass of wood $\frac{8}{10}$ of an inch thick intervened between the head of the femur and the acetabulum. The distance between the needle in the spine of the ilium and that in the lower part of the femur remained accurately the same as before the wedge was inserted. The skin seemed to drag a little on the lower needle.

This last experiment is far more decisive than the other two, but certain defects might be remedied. In the first place, the weight of the femur, always supposed to aid in the lengthening, could not, in the horizontal position, act. In the next place, the lower needle seemed a little dragged on by the skin: this appearance was very slight, it may have even been fallacious; but such draft might have been produced by one of two causes: either the thigh-bone was really pressed downward by the wedge, but the tension of the skin would not allow the needle to show that descent; or the projection of the trochanter had pulled the skin upward, and thus produced a drag upon the needle. Again, it certainly would be advisable in the next experiment to obtain some measurement of the outward projection of the trochanter. Moreover, in the preceding trial, the wedge had been driven in behind, and a little below the trochanter, and this position may have prevented the descent of the thigh.

Experiment IV.—May 10, 1860.—On the right hip of the same subject as the last, placed upon its back upon the table; all rigor mortis overcome. A measuring tape was fastened by a flat-headed nail to the last spine in the sacrum, so that it would be carried round the ilium, including the trochanter, to a needle in the symphysis pubis: this measurement was exactly twenty and a half inches. At the edge of the measuring tape, another needle was knocked into the trochanter, which was to serve not only as an index, but also as a means of securing the same position of the tape at the next measurement. Needles were fastened into the inferior anterior spine of the ilium, and in the lower part of the femur as before. Incisions were

made down to the bone previous to inserting each needle, so as to leave them free on all sides. A strap, fastened round the ankle, held a ring which permitted a system of pulleys to be hooked upon the limb. Counter-extension was made by a rope passed under the perinæum. When all things were ready, and the measurement by staff accurately procured, a system of three pairs of pulleys was hooked upon the limb, and upon its rope a weight of 28 lbs. was fastened; this procured an extending force of 756 lbs., or 6¾ cwt. There was a gentle crackling in the whole limb, but the measurements were precisely the same. Ten minutes were now allowed to elapse, and the weight was seen gradually to sink down toward the floor; at last the stretching of some part of the extension and counter-extension (either limb or rope) was so great that it was necessary to fasten the weight higher on the cord. The measurement between the needle in the ilium and that in the femur was now again taken; no difference was found; thus the weight had in no degree lengthened the thigh, *i.e.*, it had not increased the space between knee and pelvis. The cotyloid cavity was now pierced from the pelvis; measurement still showed no difference in the distance of the two needles. A considerable portion of the inner wall of the acetabulum was gouged away, as in the last experiment, and a wedge three-quarters of an inch in breadth was driven in above, and a little behind, the head of the femur. This caused the trochanter visibly to project: the measurement round that side of the pelvis and great trochanter was within a fraction of twenty-one inches. There was found, in the distance between the needle in the great trochanter and that in the symphisis pubis, a decrease of nearly two lines; this was attributable to rotation inward; but between the needle in the inferior spine of the ilium, and that above the knee, no difference in length could be detected. A wedge, just one inch broad, was now driven in directly behind the head of the femur; when it had got nearly home, considerable power was used, and the trochanter was seen to project farther at each blow of the mallet, and the needle which had been driven into it, turned like an index more and more toward the ilium. At last the trochanter projected so much, that the iliac fossa and belly of the gluteus medius formed a deep hollow; the measurement round the ilium and trochanter was now 22¼ inches; the needle in the trochanter was a fraction of a line *nearer* to the one in the symphysis pubis, showing how great rotation inward must have been. The measurement between the needle in the anterior spinous process of the ilium, and that in the lower part of the femur, remained precisely the same.

The wedge was withdrawn. The head of the bone did not return to its old place. The weight was removed from the cord. The head of the bone fell back—not suddenly, but still pretty quickly—into the socket, producing a sound precisely like that of disarticulation. The measurement in length of the femur was found precisely the same as before and during the trial.

These experiments entirely disprove the possibility of any real lengthening of the thigh (dislocation absent) as a result of either soft swelling or fluid effusion in the acetabulum; there can be and is no such thing. But another event has of late been mentioned as a cause of such an alleged phenomenon, viz., growth in length of the femoral neck. A certain abnormal growth of the affected bone was described in Chapter XI., as an occasional, though rare, sequela of ostitis occurring near the epiphysal line. I have known this to happen three or four times at the upper tibia, and I think twice at the lower femoral epiphysis. If the fact be admitted at one place, the possibility of its occurrence at another cannot be denied, although

I am bound to say that the great number of hips which I have examined have presented me with no single specimen of abnormally elongated cervix femoris. Nevertheless, ceding the possibility of such occurrence, let us consider what effect such overgrowth would have on the length of the limb as a whole. If the tibial, lower femoral, humeral, or other epiphysis overdo its work, the whole result of that exaggeration is expressed in the increased length of the bone; but the neck of the femur with the epiphysis is so oblique, that only a certain portion of what addition may be made to the cervix will be reflected as increase length of limb. The length of limb (thigh segment) is determined by a straight line, drawn from the floor of the acetabulum to the condyles—*i.e.*, the base line of a triangle whose other sides are formed, one by the shaft, the other by the head and neck of the femur. The measurements which I took on five femora of different lengths were taken thus: the place where the neck sits on the shaft was carefully selected, and on the front of the bone a line, from the upper to the lower margin of this part, was drawn; this line, corresponding nearly with the anterior intertrochanteric, was bisected, and from that point of the bone two lines were drawn, the one to the exact middle of the bone between the condyles, the other to the centre of the head; the angle was measured and reproduced on paper. Upon the lines on paper, lengths equal to the above-named parts of the bone (shaft-head and neck) were taken—the distance between the two measured. Then the shorter line corresponding to the head and neck was increased by a quarter, half, and three-quarters of an inch.[1]

The results for the five femora are as follows:

Femur.	Shaft.	Neck.	Base-line.	¼ added.	½ Inch.	¾ Inch.
1.....	16½	3	18⅝	18¾	18 15/16	19⅛
2.....	14¼	2⅜	15⅞	16 1/16	16¼	16½ nearly
3.....	14¼	2¼	15⅜	15 15/16	16 3/16	16 5/16
4.....	15	2¾	16⅞	17 1/16	17¼	17 7/16
5.....	8½	1¼	9 9/16	9¾	10 nearly	10 3/16

I do not profess that these measurements are absolutely accurate, the difficulties of correct mensuration are too great. Every femur differs slightly from others in the proportions between neck and shaft, in thickness and in length; the angle, too, varies considerably. But by this work a sort of law seems roughly established which amounts to about this, that for every ¼ inch additional growth rather more than half the same amount may be added to the whole length of the thigh. But since we have to do with a triangle we may, by trigonometry, find a more exact method if we can determine the angle between neck and shaft; this, however, varies continually as years increase, neither is it in different individuals of the same age constantly the same; the average may be taken as a right angle and a half, or 135°. If this point be lettered *B*, the intercondyloid groove as *b*, the digi-

[1] Certainly a unilateral overgrowth of the cervix femoris by ½ inch, though conceivable, has never been demonstrated, but I thought it better to take even impossible contingencies.

tal fossa of the caput as A, the shaft will be Bb, the neck and head AB, the base-line, the object of the problem, Ab; therefore the formula runs—

$$Ab^2 = AB^2 + Bb^2 - 2AB \times Bb \times \cos \angle ABb$$
$$\cos \angle ABb = \cos 135^\circ = -\sin 45^\circ = -\frac{1}{\sqrt{2}}$$
$$\therefore Ab^2 = AB^2 + Bb^2 - 2AB \times Bb \times -\frac{1}{\sqrt{2}}$$
$$= AB^2 + Bb^2 + \sqrt{2} \times AB \times Bb$$

This formula must of course be followed if the lines AB and Bb are of much the same length, but when the one is very much shorter than the other, an approximate value for the base-line Ab may be got thus—

$$Ab = Bb \left\{ 1 + \tfrac{1}{2} \sqrt{2} \frac{AB^2}{Bb} \right.$$

in other words, roughly but sufficiently accurately,

$$Ab = Bb + \frac{7}{10} \times AB$$

that is to say, the length-line is equal to the length of the shaft plus $\frac{7}{10}$ that of the neck; therefore, for every tenth of an inch additional growth of the neck .07 of an inch real lengthening may occur; thus, to construct a table:

	Inch.		Inch.
Abnormal growth	= 0.1	real lengthening	= 0.07
"	= 0.2	"	= 0.14
"	= 0.3	"	= 0.21
"	= 0.4	"	= 0.28
"	= 0.5	"	= 0.35

If abnormal growth of the femoral neck to the impossible extent of half an inch could occur, it would produce lengthening of the whole thigh to the extent of a third of an inch. That amount is during life appreciable; but it may well be questioned if such lengthening as a fourth or fifth of an inch is demonstrable. The conclusion therefore must be—That additional growth from hip disease, though quite unproven, may occur; that if it do occur it will cause lengthening to between half and three-quarters of its amount. Hence, to make an appreciable difference in the length of the limb, such suppositious growth must be large.

A LIST OF FORMULÆ.

FOR INTERNAL ADMINISTRATION.

I. Effervescent Citrate of Ammonia.

℞. Ammoniæ carbonatis..... gr. xxv.
Aquæ..... ℥ j.
M.

℞. Acidi citrici..... ℈ j.
Aquæ..... ℥ ss.
M.

The two to be poured together and taken effervescent.

II. Sulpho-Carbolate Mixture.

℞. Sodæ sulpho-carbolatis..... ℈ j.
Aquæ..... ℥ j.
M.

III. Quinine in Large Doses.

℞. Quiniæ sulphatis..... gr. x.–xx.
Acidi sulphurici aromatici. gr. v.–x.
Aquæ..... ℥ j.
M.

IV. Quinine with Bromide of Potassium.

℞. Tincturæ quiniæ..... ʒ j.–ij.
Potassii bromidi..... gr. v.–xv.
Aquam ad..... ℥ j.
M.

V. Quinine with Iodide of Potass.

℞. Tincturæ quiniæ..... ʒ j.–ij.
Potassii iodidi..... gr. iij.–x.
Aquam ad..... ℥ j.
M.

VI. Quinine with Iodine.

℞. Quiniæ sulphatis..... gr. j.–v.
Acidi sulphurici diluti..... ♏ ij.–v.
Tincturæ iodi..... ♏ v.–x.
Aquam ad..... ℥ j.
M.

VII. Compound Iodine Mixture.

℞. Potassii iodidi..... gr. iij.–v.
Tincturæ iodi..... ♏ v.–x.
Aquam ad..... ℥ j.
M.

VIII. Nascent Iodide of Iron.

℞. Potassii iodidi..... gr. iij.–v.
Tincturæ iodi..... ♏ v.–x.
Aquam ad..... ℥ ss.
M.

℞. Ferri et ammoniæ citratis... gr. v.–x.
Ammoniæ carbonatis..... gr. iij.
Aquæ..... ℥ ss.
M.

To be mixed together just before administration.

IX. Quinine with Mercury.

℞. Hydrargyri iodidi rubri..... gr. ⅛–¼
Quiniæ sulphatis..... gr. j.–ij.
Confectionis rosæ..... q. s.
M., ft. pilula.

X. Another.

℞. Quiniæ sulphatis..... gr. ij.–v.
Acidi hydrochlorici diluti.. ♏ v.
Liq. hydrargyri perchloridi. ʒ j.
Aquam ad..... ℥ j.
M.

XI. Another, for Children.

℞. Hydrargyri c. cretâ..... gr. ij.
Quiniæ sulphatis..... gr. j.
M., ft. pulv.

To be given in a little jam.

XII. Colchicum and Mercury.

℞. Pilulæ hydrargyri..... gr. ij.
Ext. colchici..... gr. ss.
Conf. rosæ..... gr. ijss.
M., ft. pilula.

XIII. Iodo-Alkaline Mixture.

℞. Potassæ bicarbonatis,
Potassæ nitratis.....āā gr. x.–xv.
Potassii iodidi..... gr. iij.–v.
Aquæ..... ʒ j.
M.

With this either the wine of colchicum (♏ x.–xv.) or infusion of digitalis (ʒ j.–ij.) may be combined.

XIV. Aconite in Severely Painful Disease (Rheumatic or Gouty).

℞. Tincturæ aconiti..... ♏v.
Aquæ..... ℥ ss.
M.

Every three hours, or one drachm of same every half-hour.

XV. Iodine and Guaiacum.

℞. Potassii iodidi..... gr. v.
Tincturæ guaiaci ammoniatæ.. ʒ j.
Mucilaginis acaciæ..... ʒ ij.
Aquam ad..... ʒ j.
M.

XVI. Salicylate of Atropia.

℞. Atropiæ..... gr. v.
Acidi salicylatis..... gr. vijss.
Aquæ calidæ..... ʒ x.

Rub down the atropia into a very fine powder, then little by little the salicylic acid with it. Add the water slowly. The whole must measure 10 ounces. Dose 10 minims, *i.e.*, $\frac{1}{100}$ gr. (accurately $\frac{1}{96}$) of atropia.

XVII. Mixture for Starting-Pains.

℞. Liq. atropiæ salicylatis..... ♏v.–x.
Tincturæ opii..... ♏v.–xv.
Liquoris strychniæ..... ♏v.–x.
Aquam ad..... ℥ ss.– ʒ j.

XVIII. Bromide and Valerian.

℞. Potassii bromidi..... gr. xv.–xx.
Tincturæ valerianæ..... ♏x.–xv.
Aquam ad..... ʒ j.
M.

XIX. Antihysteric.

℞. Quiniæ sulphatis..... gr. ij.
Zinci valerianatis..... gr. ijss.
M., ft. pilula.

XX. Another Form.

℞. Extracti cannabis indicæ..... gr. $\frac{1}{4}$–$\frac{1}{2}$
Zinci valerianatis..... gr. ijss.
M., ft. pilula.

XXI. In Neuroses with Excitement.

℞. Extracti cannabis indicæ..... gr. $\frac{1}{4}$–$\frac{1}{2}$
Extracti physostigmatis..... gr. $\frac{1}{8}$–$\frac{1}{6}$
Micæ panis..... q. s.
M., ft. pilula.

FOR EXTERNAL APPLICATION.

a. Rubefacients and Counter-irritants.

1. ℞. Iodi..... gr. 60–70
Alcohol absoluti..... ʒ j.
Solve. (Demme.)

2. ℞. Argenti nitratis..... ʒ j.–iss.
Acidi nitrici..... ♏iij.–v.
Aquæ destillatæ..... ℥ j.
Solve.

3. ℞. Tincturæ iodi..... ℥ j.
Linimenti ammoniæ..... ℥ iv.
M.

4. ℞. Tincturæ iodi..... ʒ ij.
Glycerini..... ʒ ij.
Linimenti saponis..... ʒ iv.
M.

5. ℞. Acidi sulphurici..... ʒ iss.
Olei olivæ..... ℥ iss.
Olei terebinthinæ..... ℥ ss.
M. (Brodie.)

6. ℞. Potassæ bicarbonatis..... gr. x.
Potassii iodidi..... gr. v.
Aquæ..... ℥ j.
As a compress.

7. ℞. Acidi carbol. liquef... ♏xx.–xxx.
Aquam ad..... ℥ j.
M. As a compress.

8. ℞. Iodi..... gr. v.
Ætheris..... ♏xx.
Solve et adde
Olei morrhuæ..... ℥ j.
M. As a compress.

b. Absorbents.

9. ℞. Unguenti potassii iodidi,
Unguenti plumbii odidi,
M. Æquales partes.

10. ℞. Unguenti cadmii iodidi,
Unguenti potassii iodidi,
M. Æquales partes.

11. ℞. Unguenti hydrargyri,
Unguenti plumbi iodidi,
Unguenti potassii iodidi,
M. Æquales partes.

12. ℞. Hydrargyri iodidi viridis... ʒ j.
Adipis præparatæ..... ʒ vij.
M.

13. ℞. Hydrarg. oxidi flavi. gr. v.–x.–xx.
Acidi oleici....gr. xcv.–xc.–lxxx.
M.

c. ANODYNES.

14. ℞. Extracti belladonnæ,
Glycerini.....Æquales partes.

15. ℞. Liq. atropiæ sulphatis. ʒ ij.–℥ ss.
Glycerini..... ℥ ss.
Aquam ad..... ℥ ij.
M.

16. ℞. Tincturæ opii..... ʒ j.
Liquoris atropiæ salicylatis. ʒ j.
Aquæ..... ʒ vij.
M.

17. Unguentum atropiæ. (Brit. Pharm.)

18. ℞. Linimenti belladonnæ..... ʒ vij.
Chloroformi belladonnæ.... ʒ j.
M. As compress for a few minutes. (Squires.)

19. ℞. Linimenti aconiti,
Linimenti belladonnæ,
Æquales partes. Painted on with small brush.

20. Chloroformum aconiti. (Squires.)

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